for

engineers and contractors controlling the design, specification, installation and maintenance of heating, ventilating and air conditioning.

HEATING AND VENTILATING

The Air Conditioning Monthly

PUBLISHER

THE INDUSTRIAL PRESS

President
ROBERT B. LUCHARS

Vice-President and Treasurer
EDGAR A. BECKER

Secretary
ERIK OBERG

EDITORIAL STAFF

Editor
CLIFFORD STROCK

Assistant Editor
R. N. HOSEY

PUBLISHING INFORMATION

HEATING & VENTILATING is published monthly by the Industrial Press at 148 Lafayette Street, New York, N. Y. Western office, 228 North La Salle Street, Chicago, Ill. Yearly subscription in the United States, Spain, South America, Mexico, and Canada, $2.00; in all other countries, $3.00. Single copies 30 cents.

ADVERTISING REPRESENTATIVES

Eastern Representative
ALGWYNNE COLLINS
148 Lafayette Street
New York, N. Y.

Western Representative
GEORGE G. TURNER
228 North La Salle Street
Chicago, Ill.

Copyright, 1942, by the Industrial Press

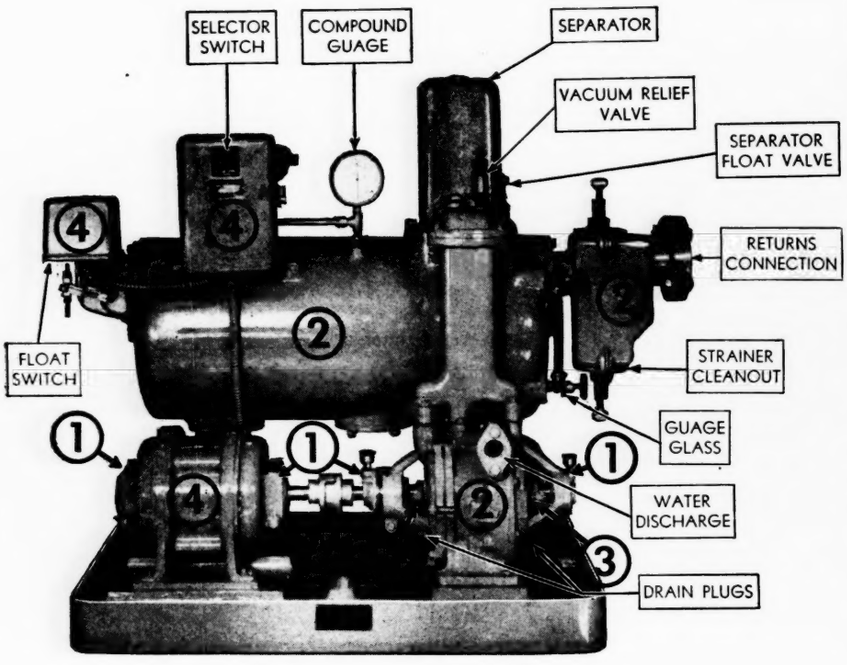
CONTENTS FOR JUNE, 1942

VOLUME 39 NUMBER 6

Simplification Stressed	19
The Health Hazard of Refrigerants	21
Tropopause Studies to Aid Long-Range Forecasting	23
Air Flow Measurement by the Dilution Method	24
Orchids Grown in Cleaned Air	26
Profits in Air — Minneapolis Show Case Mfg. Co.	28
Profits in Air — Syracuse Post-Standard	29
Profits in Air — Reliance Electric & Engineering Co.	30
The Application of Organic Amines to Steam Engines	31
Theory vs. Practice — Radiator Sizing and Changes	34
Reference Section 5 — Saving Fuel in Heating	35
The Welding of Piping — II	51
Pointers on How to Conserve Equipment	55
Fuel Oil and Burner Restrictions Tighten	58
Reference Data 223 and 224	58
Where Is the Sun?	59
Washington News	62
Washington Briefs	65
Abstracts	66
News of the Month	69
New Equipment	72
Degree Days for April, 1942	80
New Trade Literature	82
With the Manufacturers	86
Personals and Personnel	86
Coming Events	87
H & V's Photos	87

MEMBER
Audit Bureau of Circulation
Associated Business Papers

How to keep your Jennings Heating Pumps in First Class operating condition for Duration...



YOUR JENNINGS RETURN LINE VACUUM HEATING PUMPS

are an important part of plant or building equipment. They cannot be easily replaced and must last for a long time. Jennings Pumps are designed for long life, and have extra capacity which will count when it may be difficult to maintain lines and equipment free from leaks, but to give full service they must have proper care.

Now that these pumps have been in service all winter on the heating system, they should have a thorough inspection. Special attention should be given to the bearings, as no wearing contact occurs in a Jennings Pump as long as the ball bearings are properly maintained.

In most cases Jennings Pumps will require only the check-up we have recommended. If additional adjustments or repairs are found to be necessary, they should be undertaken at once. Do not wait until both time and materials are running short. Nash Service Branches are established throughout the United States. If you do not know the address of the one nearest to you, write directly to this office. Nash Service is yours to command, NOW.

SERVICE POINTERS

1 **LUBRICATE PUMP AND MOTOR BEARINGS . . .** Check bearings for end play, or radial play, and be sure they contain no grit, or foreign matter. If found to be clean and in good condition, fill with proper non-acid grease lubricant. If motor has oil lubricated bearings, flush out with fresh oil, and refill.

2 **CLEAN STRAINER AND STRAINER SCREEN . . .** Clean strainer well and strainer screen. If screen is found to be worn, and has passed foreign matter, thoroughly flush both receiving tank and pump casing. Drain plugs are conveniently located . . . Damaged screen should be repaired or replaced at once.

3 **RENEW STUFFING BOX PACKING . . .** Remove old packing and clean stuffing box. Fill with new loose-woven graphite-impregnated stuffing box packing, in individual rings. Be sure joints are staggered, and that ends butt properly without over-lapping. Do not finally tighten gland until pump is again in operation.

4 **HAVE MOTOR AND CONTROL INSPECTED . . .** Have an experienced electrical service man go carefully over motor and control. Follow his recommendations and if repairs or replacements are indicated, have the work done immediately.

5 **CHECK OPERATOR'S INSTRUCTION BOOK . . .** If operating instructions originally furnished with the pumps have been lost, write to us at once for a new copy for each pump. BE SURE TO FURNISH US THE TEST NUMBER OF EACH PUMP, as stamped on the pump name plate.

6 **IF PUMPS REQUIRE REPAIRS . . .** and you do not know the address of our nearest Service Branch, notify us at once, and we will have our Service Engineer get in touch with you without delay . . . There are well equipped Nash Service Branches in most principal cities, ready to give you every possible help.

NASH ENGINEERING COMPANY

254 S. WILSON ROAD • SOUTH NORWALK, CONN.

Air conditioning grilles and ducts were blended into the decorative scheme at the Greenfield Specialty Store, St. Louis. Instead of branch return ducts, one main grille in each floor near the floor level returned the air back for recirculation.

SIMPLIFICATION STRESSED

in air conditioning system for a St. Louis department store, with installation cost reduced to a minimum. Method explained by W. P. Norris of Natkin & Co., St. Louis, installers of the Air Conditioning system.

A GOOD example of simplification and elimination of non-essential items is the recently installed air-conditioning system at Greenfield's, a prominent specialty store in St. Louis. Advantage was taken of every peculiarity of occupancy or construction with the result that the installation cost was cut to a minimum.

The building was built about forty years ago as a retail specialty store and has been used for that purpose ever since. In the latter part of 1940 the owners of the building agreed to undertake a modernization program, and the St. Louis architectural firm of LeBaume & Klein was commissioned to execute the necessary design work involved. This program included, in addition to the air conditioning system, the complete refacing of the exterior of the building facing the street; the erection of new and larger show windows; complete modernization and redecoration of the first and third floors; installation of fluorescent lighting and several other minor alterations.

Since the volume of retail trade in which this firm is engaged is naturally at a low ebb during the summer months, it was desirable that the system design and equipment were essential to satisfactory operation and in accordance with sound engineering principles and that all gold braid and chromium plating be left off.

The building is four stories, measuring approximately 100 by 85 ft, with basement—the basement not being air conditioned. The first three floors are used as sales space and the top floor for offices and service departments which can at some later date be converted to sales space.

The building is situated on the northeast corner of the downtown intersection so that it has a South and

West exposure. An abnormal percentage of glass added substantially to the cooling load.

Simplification of the installation was greatly enhanced by virtue of the fact that there were no interior partitions in the building other than a few fitting rooms and some office rooms on the fourth floor which had seven-foot partitions, with no ceilings. This eliminated the necessity of any small branch ducts to individual rooms.

Calculations indicated a cooling load of 68 tons of refrigeration based on cooling from an outside condition of 95F dry bulb and 78F wet bulb to an inside condition of 80F dry bulb and 50% relative humidity. The design occupancy is 150 persons; the lighting load is 35,000 watts. About 5600 cfm of outside air is introduced, providing one change of air per hour.

To carry this load a Westinghouse type CLS-2550 hermetically-sealed air conditioning compressor was used. The unit is driven directly by a 75 hp, 870 rpm motor operating on a 3-phase 208-volt circuit. A 3-row cooling coil having a total finned area of approximately 52 sq ft was used and a filter bank consisting of forty-two 16 x 25 in. throw-a-way type filters was placed behind the coil. A 49 in. diameter single-inlet, single-width fan was used as a supply fan driven through a V-belt drive by a 10 hp, 1750 rpm motor. Approximately 33,000 cfm of air was circulated at a discharge temperature of 65F dry bulb. The outlet velocity of this fan was approximately 2400 fpm which could have produced, under normal circumstances, an excessive noise level. However, this was more than offset by the fact that immediately adjacent to the air conditioning equipment was a direct drive pneumatic tube evacuator operating at 3600 rpm.

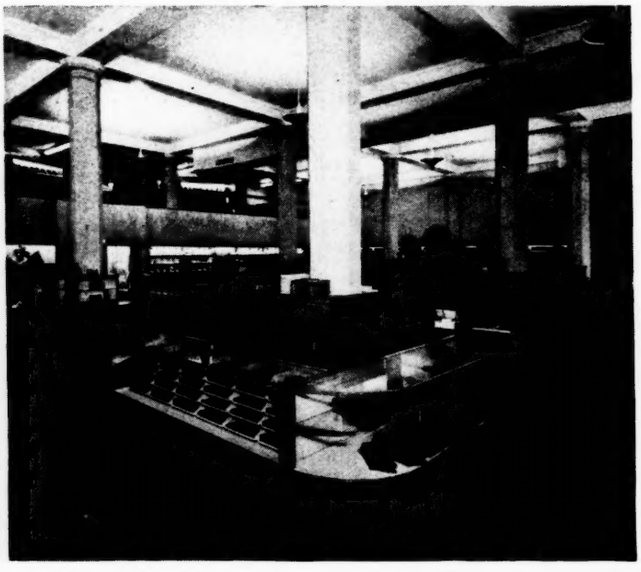
All of this equipment was located in the basement of the building in a space approximately 10 x 20 ft. In addition to this equipment an evaporative condenser was located on the roof of a one-story annex of the building occupied by another tenant.

Main supply and return air ducts were carried up the center of the rear wall of the building immediately adjacent to the elevator shaft. The initial velocity of the air in the supply duct was approximately 1800 fpm and decreased from that to approximately 1100 fpm in the last section of the last branch duct. A branch duct was carried across the ceiling of each floor at the center of the building, decreasing in size at each outlet. No branch return ducts were used, there being one main return grille in the return duct on each floor near the floor level. On the first and third floors where new fixtures were installed these return grilles were located at the direction of the fixture installers to fit into the decorative scheme in the most desirable fashion.

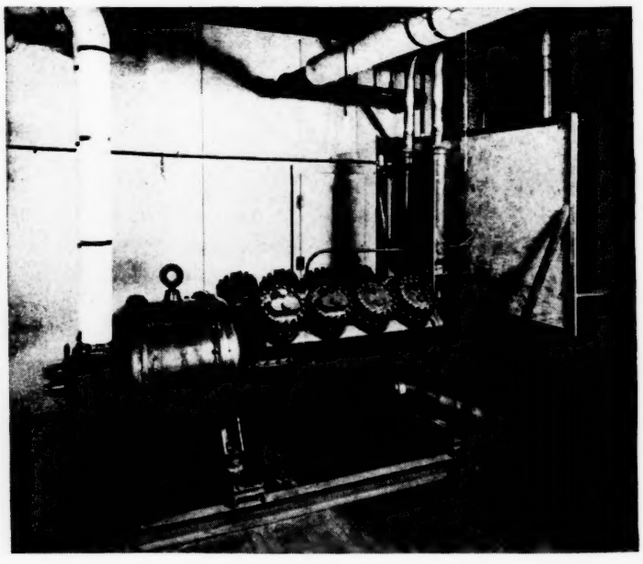
Supply grilles were equipped with individually adjustable bars in both a horizontal and vertical plane. This permitted any direction of throw or any degree of convergence or divergence. Because of the high ceilings a rather high discharge velocity from the grilles, 700 to 900 fpm, was considered both desirable and economical. Outside air was brought from a louver in a window on the second floor.

All the refrigerant piping was constructed of type L copper pipe. In place of standard ells pipe was bent by means of a hydraulic bending machine to the degree of curvature desired. This has the added advantage of producing a long radius elbow with negligible frictional loss and eliminated the possibility of leaks developing at the joints. A high temperature brazing material was used in lieu of solder.

No zone control was deemed necessary and the entire system is controlled by a single two-stage thermostat located in the return air duct in the basement. Upon a drop in temperature the thermostat first unloads the compressor fifty per cent by means of built-in cylinder unloaders and a solenoid valve in the liquid refrigerant line cuts off fifty per cent of the cooling coil; upon a further drop in temperature the compressor and the evaporative condenser fan and pump are turned off. The two points on the thermostat are about one degree apart.



Due to the high ceilings in the Greenfield Specialty store, the discharge velocity from the grilles was stepped up to 800 fpm. Outside air is brought from the second floor.



A Westinghouse 75-ton hermetically sealed air conditioning compressor which handles the air conditioning load at the Greenfield department store in St. Louis

The Health Hazard of Refrigerants

By F. W. HUTCHINSON

Assistant Professor of Mechanical Engineering,
University of California, Berkeley, Calif.

This article is one of a series by the author on the health aspects of various phases of heating, ventilating, or air conditioning. Although these articles are tied together by their viewpoint, each is separate and self-contained. Previous articles in this series were: Health vs Comfort vs Efficiency, Nov. 1941; Temperature as a Health Factor in Air Conditioning, Dec. 1941; The Paradox of Acclimatization, Feb. 1942; Humidity as a Health Factor in Air Conditioning, April 1942.

ABOUT one hundred years ago (1844), Thomas Masters, an English inventor, scholar, and eccentric, wrote one of the earliest texts on refrigeration. The title was "The Ice Book; A Compendious and Concise History of Everything Connected with Ice." Among other curiosities the author described an ice-salt refrigerating "machine" which he had designed and explained that it was a desirable adjunct to any home not alone because of its utility, but also because it can be relied upon to "beautify and adorn" the room in which it finds a place.

After discussing the technical characteristics of this device, the author returns once more to the art of persuasion and submits innumerable recipes for the preparation of frozen desserts. In conclusion, and with an unbecoming lack of modesty, he expresses the belief that "Mr. Masters—may be regarded as the first to bring the science of refrigeration to perfection."

Aside from its interest as a historical curiosity the above book is pertinent to this paper in that it brings to light the fact that the health hazard associated with artificial cooling is older even than mechanical refrigeration, going back to the earlier forms of simple ice-salt cold boxes. Convinced though Masters is that his refrigeration system is a success, he finds it necessary to confess that refrigerants are somewhat open to objection "on account of their destructive effects on the garments of servants and others not sufficiently observant of the cautions necessary to their use, and secondly, on account of the great nuisance arising from the disengagement of hydrochlorate acid."

The only way in which the above statement differs from present thought is that it places responsibility for the "great nuisance" on the shoulders of the persons who permit themselves to be poisoned, while the public health officer of today places it with the engineer who persists in the use, or misuse, of toxic materials.

In general, however, modern refrigerants are better able to defend themselves than are most other toxic engineering materials. It is true that they sometimes constitute a hazard to health, but against this charge is arraigned the endless list of safeguards to, and advances in, public health which their use has made possible. The reduction in poisonings from contaminated food and the increase in human comfort which air conditioning is making possible are but two of the many ways in which refrigerants have justified the risk which their use involves.

As has been true of so many other materials, the greatest hazard associated with modern refrigerants has been the too rapid commercialization of new and untried products. Frequently such products have been offered as harmless and non-toxic; not until considerable time has passed do the toxic effects make their appearance. Similarly, time is often required to reveal concealed dangers. As an example, the halogen compounds (as methyl chloride and carbon tetrachloride) were in use for a long time before the discovery was made that these materials, in very low concentrations, can have a toxic effect when exposure is over a long period of time. Similarly, it was not at first realized that carbon tetrachloride and dichlorodifluoromethane may decompose in the presence of a flame to yield highly toxic phosgene gas.

The health hazards associated with refrigerants can usually be grouped under four headings: (1) Fire; (2) Explosion; (3) Escape; and (4) Decomposition. In addition to what might be called the "absolute toxicity," that is the toxic effect when the refrigerant is actually in contact with a person, the degree of the hazard represented by a given refrigerant is also a function of the possibility of remaining in contact with an individual for a length of time sufficient to permit the toxic qualities to become operable. By this standard ammonia and sulphur dioxide are irritants which, on escape, are immediate and well known dangers to life, but the possibility of any individual (who is able to escape) remaining in an atmosphere contaminated with either of them is remote; in that they afford a definite and extremely irritating warning, their use probably entails a lesser hazard than does the use of a less toxic but non-irritating refrigerant. Noting that odor alone is insufficient to awaken a sleeping person, it has become customary to add some material such as a stertagent to induce sneezing and mechanically awaken the occupants in the event of a refrigerant leak.

The toxic qualities of the more commonly used refrigerants are discussed briefly in the sections which follow:

Ammonia. Ammonia has been used for so long and its properties are so well known that it receives scant attention in the current literature. Exposure to a concentration of .03% by volume for a period of one hour is believed to be the maximum limit beyond which there is likelihood of permanent injury to health. Con-

centrations of .5 to 1.0% may be lethal if the exposure time exceeds a half hour. This refrigerant should not be permitted to come in contact with red-hot metal or an ordinary flame for under these conditions the vapor will decompose, ignite and possibly explode. Explosive mixtures range from 13% ammonia with 87% air to 27% ammonia with 73% air.

Sulphur Dioxide. Sulphur dioxide is not combustible and does not represent an explosion hazard. Its pungent and suffocating odor makes it extremely unpleasant to remain in an atmosphere even when the concentration is very low and for this reason—in spite of its toxic qualities—the literature has little to offer in the way of fatal case histories. However, a serious and not widely recognized hazard is the possibility of chronic poisoning resulting from long exposure to minute concentrations.

A recent investigation was reported covering one hundred workers who had been exposed from 4 to 12 years to sulphur dioxide of concentrations ranging from .0005 to .007% by volume; comparing them with 100 non-exposed controls, tonsillitis, abnormal reflexes, acid urine, increased fatigability, shortness of breath and altered sense of taste and smell were all found to a greater degree in the exposed group.

Carbon Dioxide. Carbon dioxide has been superseded, particularly in air conditioning, by refrigerants which do not require such high pressures. Its use is sufficiently widespread, however, and the hazard which it represents in uses other than as a refrigerant is of sufficient magnitude to justify a place for it in this paper. Carbon dioxide is not inflammable and has a tendency to smother combustion. When breathed in concentrations of 2% by volume efficiency is reduced, headache and drowsiness result. With 2%, the lung volume is increased 50 to 100%, but respiratory rate is unchanged; for 3% lung volume is increased 100 to 150% and respiratory rate starts to increase. Except in children under 6 years of age 1% has no effect on respiration. According to Haldane and Priestly the lung action is increased about 500% for 6% CO_2 and breathing then becomes difficult; with more than 10% there occurs a loss of consciousness, but no immediate danger of life. Brief exposure to an atmosphere containing as high as 25% CO_2 need not result in immediate death, but is very hazardous.

The above concentrations apply only for CO_2 in air which has a normal oxygen content. Middleton, for example, tells of the asphyxiation of 5 caisson workers in air having a 14% CO_2 and 12% O_2 content; in passing over an organic river bottom it had become deoxygenated.

Probably the importance of CO_2 as a health hazard will increase as time goes on for it is finding new and extensive uses in industry. Swedish investigators have found that an atmosphere high in CO_2 is of assistance in the preservation of stored eggs while recent American publications discuss the use of "synthetic atmospheres" and cite data to show that an increase in CO_2 and a corresponding decrease in O_2 may result in a cold storage atmosphere which has a decidedly beneficial effect on certain types of stored food products. If cold storage systems of this kind were to gain acceptance the CO_2 hazard might become of major industrial importance.

Fluorine Derivatives. Within recent years, and as a direct result of a wide acceptance of domestic mechanical refrigeration, a group of fluorine derivatives have become important as refrigerants. These include dichlorodifluoromethane, dichlorotetrafluoroethane, trichloromonofluoromethane, and monofluorotrichloromethane.

Dichlorodifluoromethane is apparently non-toxic; experiments at the U. S. Bureau of Mines showed that animals can withstand a concentration of 20% by volume for such long periods of time that "the possibility of accident hazards resulting from exposure to dichlorodifluoromethane when used as a refrigerant is remote." Computation indicates that a health hazard is not created even when this material is brought in direct contact with a flame, but one experimenter states that decomposition in the presence of a flame does yield phosgene.

Dichlorotetrafluoroethane is described by the U. S. Bureau of Mines as an organic vapor of low toxicity.

Monofluorotrichloromethane is rated (along with carbon dioxide) in Group 5 of the National Board of Fire Underwriters' classification. This rating would place it between methyl chloride (see below) and dichlorodifluoromethane.

Halogen Compounds. Of the halogen compounds that find use as refrigerants, methyl chloride and carbon tetrachloride are the most important. Experiment has shown that both of these compounds may be toxic in small concentrations when exposure is for 7-8 hours a day over considerable periods. Since each of these fluids finds extensive use in industry for purposes other than as a refrigerant, the literature contains innumerable references to the toxic properties.

Methyl chloride has been in use in Europe for many years, but its introduction into the United States did not take place until about 1915. It is a non-irritating, colorless, sweet smelling gas which is explosive when in a 10 to 15% concentration if exposed to a flame or white hot wire. The National Board of Fire Underwriters rate it in Group 4, which group, in concentrations of 2.0 to 2.5% by volume (in air in absence of flame or hot object) is lethal for exposures of two hours; in presence of a flame 2.5% is lethal in less than ½ an hour. As a refrigerant for household use it has been compared with ammonia and SO_2; when the concentration exceeds 10% methyl chloride acts as an anaesthetic. One recent report presents seven case histories of poisoning by methyl chloride; the cases are taken from manufacture, repair and installation of domestic refrigerators.

The U. S. Bureau of Mines has studied the possibility of poisoning by food or water that (in a domestic refrigerator) had absorbed methyl chloride. Their findings indicate that there is no hazard connected with absorption by milk or food and that saturated water (while somewhat poisonous) would taste so bad that there would be little likelihood of anyone drinking more than one mouthful. In a later report the Bureau suggests that acrolein be used as a warning agent in methyl chloride refrigerators. The addition of 0.6 to

1.0% acrolein by volume is enough to give warning of leakage of liquid when the concentration of methyl chloride in the air is .0066 to .01% volume or .066 to 10% methyl chloride if the leakage is vapor.

Carbon tetrachloride is not widely used as a refrigerant, but it has many uses in industry and is one of the more important toxic materials. It is only within the last few years that the danger of chronic CCl_4 poisoning has been recognized. In spite of the hazard, there is evidence to indicate that industrial CCl_4 poisoning is relatively rare. Existing data support the belief that 0.1% is a hazardous concentration for continuous exposure and .1% is hazardous for periods exceeding ½ hour per day. If an average nose recognizes more than a faint odor of the solvent on entering the workroom, an increase in ventilation is called for.

The acute effects of this material are evident from a consideration of cases described in the literature. As an example, one case is described involving a workman who for two hours watched the washing of skins in a rotating drum; at the end of this period he was found dead. Mild occupational CCl_4 poisoning results in nausea and vomiting with development of nephritis and impairment of the kidney function.

In addition to its hazard as a vapor, carbon tetrachloride offers the additional hazard of decomposition in the presence of heat with the formation of phosgene and other toxic gases. Cases have been described of poisoning resulting from the use of a Pyrene fire extinguisher in a poorly ventilated room. Experimental investigations show that the use of CCl_4 to extinguish small fires in sealed compartments results in a phosgene concentration averaging .0236%; CCl_4 dropped on a red hot beam (no fire present) gave a phosgene concentration of .0119%.

There are, of course, many substances other than those described above that find use as refrigerants. However, water is the only completely non-toxic one.

Tropopause Studies to Aid Long-Range Weather Forecasting

A rising and falling of the earth's tropopause due to day-to-day variations in the heat of the sun is pictured as a possible fundamental element in world weather by Dr. Henryk Arctowski, noted Polish meteorologist, now conducting investigations at the Smithsonian Institution.

Dr. Charles G. Abbot, Secretary of the Smithsonian, has established long since that solar radiation varies frequently by as much as half of one percent, and occasionally several times that. These variations occur in a series of cycles repeated every 9¾, 11, 21, 25, 39½, 46, and 68 months.

But the fact that the outer atmosphere of the earth is receiving more heat from the sun on a certain day than on the day before does not mean that the whole surface of the earth will be that much warmer. The radiation must pass through an ocean of atmosphere at least 100 miles thick before it strikes the earth. Some parts of the globe become warmer and some cooler due to such factors as changes in degrees of cloudiness, effects on wind direction and intensity, effects on the movements of air masses in the high atmosphere, etc.

But somewhere there is an initial effect—"a direct hit," as it is described by Dr. Arctowski. In seeking the point of this direct hit, he finds the most probable location is the vaguely defined surface which marks the bottom of the stratosphere — the point where temperature decreases with altitude comes to an end.

Recently Dr. Arctowski announced his discovery of two stratospheres over the temperate zones of the world—a real one sloping toward the poles from the equator and the pseudostratosphere sloping upward from the poles toward the equator.

His investigations indicate, Dr. Arctowski reports, that the solar radiation variations cause changes in the altitude of this surface over the tropics, where it normally is about 11 miles high, and that these changes proceed northward and southward in wave-like motions.

An extra half of one percent of solar radiation appears to have somewhat the same effect as a stone dropped into a quiet pond, setting up waves which proceed in all directions toward the shores. The height of the real tropopause, Dr. Arctowski's investigations show, actually seems to vary with the radiation changes and to vary by different amounts in different latitudes according to a definite pattern.

An up-and-down movement of the tropopause, in turn, causes a variation in the height of the highest clouds and in the movements of air masses, now considered perhaps the most fundamental factor in weather. These effects cause different precipitation effects in different parts of the earth.

To prove the thesis, Dr. Arctowski admits, is extremely difficult because of the extreme delicacy and liability to error of solar radiation measurements. They are determined daily on high mountain tops scattered over the western hemisphere by Smithsonian observers, but they cannot be measured directly. Many calculations must be made to eliminate the effects of the ocean of atmosphere through which solar radiation passes before it can fall on the Smithsonian instruments.

If Dr. Arctowski's contentions could be proved they might constitute one of the greatest steps ever made toward successful long range forecasting—but it is first essential that some means be invented of measuring the radiation at the base of the stratosphere in different parts of the world.

Air Flow Measurement by the Dilution Method

By THEODORE HATCH and ROBERT H. WALPOLE, JR.

Department of Public Health and Preventive Medicine, School of Medicine, University of Pennsylvania

PROBLEMS in air flow measurement are encountered in which it is not possible to confine the air stream entirely and force it through a meter or past a definite velocity-measuring station. Under these conditions, the rate of air flow may be determined by the dilution method wherein a test gas is fed into the air stream at a known rate and, after uniform mixing is established, its concentration is determined in a unit volume of air. The rate of feed of the gas divided by its resulting concentration equals the rate of air flow.

The test gas must be one that is not absorbed either chemically or physically in the system and, for general use it must not be toxic or explosive. It should lend itself to collection and measurement by means of simple sampling apparatus and analysis. Carbon dioxide meets these requirements. It is readily available in pressure cylinders and may be fed at a constant rate through a standard pressure-reducing valve and flow meter. It is easily absorbed in an alkaline solution and is quickly determined by simple titration with as high an accuracy as may be desired. For approximate tests, a portable CO_2 analysis apparatus of the volumetric type may be employed. It is, of course, necessary to subtract from the total amount of CO_2 in the sample that amount which is normally present in the air in order to determine the concentrations of the added gas.

The basic apparatus required for air flow measurement by the dilution method is shown in Fig. 1 and the various parts are enumerated below:

1. Cylinder of CO_2.
2. Constant pressure valve.
3. Flow meter, calibrated in grams of CO_2 per minute at 760 mm. Hg. and 0°C. Correction values for other pressures and temperatures are arranged in a convenient table.
4. Gas-feeding tube, arranged to insure uniform mixing of the test gas with the air stream.
5. Sampling tube.
6. Dust filter (when required).
7. Sampling apparatus, including absorption flask and flow-meter.
8. Source of suction:

Many combinations of feeding and sampling equipment will suggest themselves. The apparatus should be simple, rugged and positive in operation. The flow meter for feeding the CO_2, for example, may be built into the pressure-regulating valve while a hand-operated, constant-flow pump may be employed with the sampling apparatus.

Accuracy

The accuracy of the dilution method, using CO_2 as the test gas, depends upon the following:

1. Uniformity of mixing of the CO_2 with the air stream.
2. Accuracy of flow meter in the feeding apparatus.
3. Accuracy of the analytical procedure employed for determining the CO_2 concentration in the air stream.
4. Ratio of the concentration of *added* CO_2 to the normal atmospheric content of this gas.

Complete mixing of the test gas with the air stream is obviously essential. It is readily obtained in a simple air stream in which the air enters through a single inlet and the sampling point can be located a considerable distance downstream. In a complex flow system, however, with numerous inlet and discharge openings and with opportunities for short-circuiting of the test gas, considerable care must be exercised to insure thorough mixing. In certain cases we have found it necessary to introduce the CO_2 into two or more of the secondary air streams before they join to form the main stream. Proof of uniform mixing is demonstrated

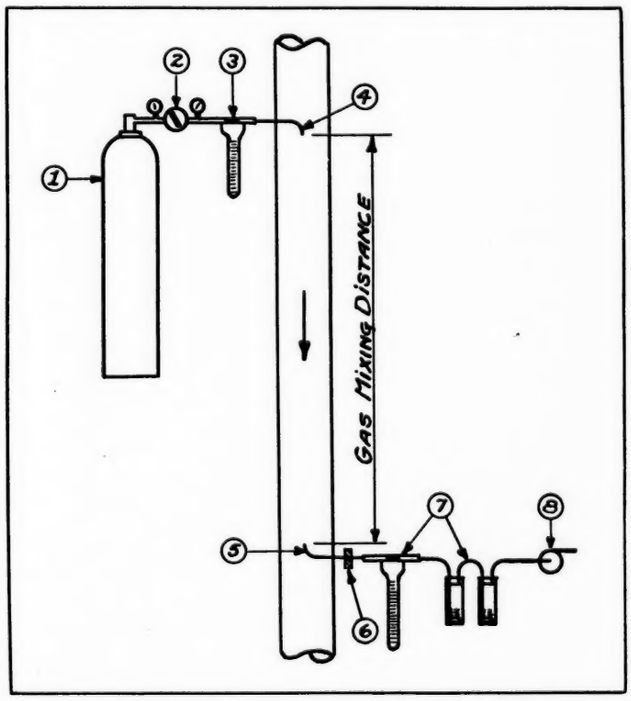


Fig. 1. Diagrammatic arrangement of apparatus for measurement of air flow by the dilution method.

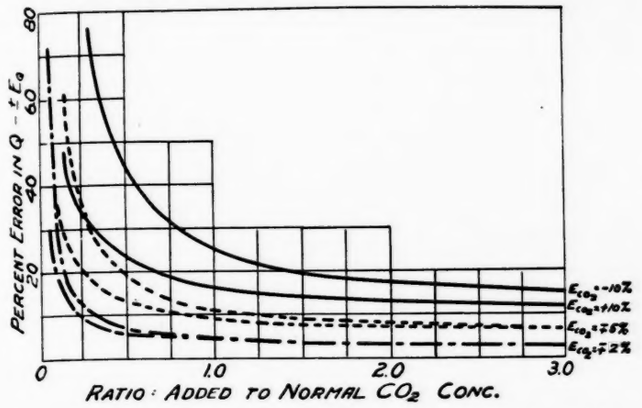


Fig. 2. Percent error in air flow measurement in relation to ratio of added to normal atmospheric CO_2 concentration.

when the concentration of the CO_2 is found to be the same at the several points of discharge.

The accuracy of rate of feed of the test gas depends upon the design and calibration of the flow meter, the corrections that are applied for the effects of temperature and pressure and the constancy of flow during the test. These are subject to direct control and the error may be fixed to meet the demands of the problem. This is also largely true with respect to the analytical procedure employed to determine the CO_2 concentrations. A number of methods for measuring this gas are described in standard textbooks on gas analysis. The volumetric method, in which the change in volume of the sample resulting from absorption of the CO_2 is measured directly, is perhaps the simplest. It requires no separate sampling device nor is chemical titration involved. The standard instrument, however, does not measure the concentration more closely than to 1 part in 10,000 and, since the amount of gas added may not exceed 6 to 8 parts in 10,000 the accuracy of the air flow measurement will be ± 15%. More accurate methods depend upon the absorption of the CO_2 in an alkaline solution of known strength and determination of the amount collected by acid titration. This requires an accurate flow meter, an efficient absorption device, protection of the absorption liquid from contamination with CO_2 from the air before and after sampling and careful chemical analysis. It is capable, however, of measuring the CO_2 concentration with a high degree of accuracy. With simple apparatus and analytical procedures which are adaptable to field conditions, an accuracy of ± 5% is readily obtained.

The ratio of the concentration of *added* gas to the normal atmospheric content is, next to uniformity of mixing, the most important factor in determining the accuracy of air flow measurement by the dilution method. The error in air flow measurement increases as the ratio of added to normal CO_2 decreases, as indicated by the following equation:

$$1 \pm \frac{E_Q}{100} = \frac{R}{\left|\left(1 \mp \frac{E_{co_2}}{100}\right)(R+1)\right| - 1}$$

Where E_Q = Per cent error in air flow measurement.
E_{co_2} = Per cent error in CO_2 concentration
R = Ratio of added to normal CO_2 concentration

The relation between E_Q and R is plotted for three values of E_{co_2} in Fig. 2. These curves exhibit sharp breaks at certain values of R below which the accuracy of air flow measurement decreases rapidly. For an error of ± 5% in the CO_2 determination, the critical ratio is approximately 1.5 and this minimum value has been selected for practical field work, thus giving an accuracy of air-flow measurement of ± 10%. This requires a minimum rate of CO_2 feed of 34 grams per 1000 cu ft of air at sea level. The feeding apparatus should be provided with several interchangeable flow meters to cover the range of air flow rates to be measured and in a particular problem it is necessary to select the proper rate of CO_2 feed from an initial estimate of the air flow and subsequent trial.*

Application

The dilution method has been found particularly useful in studies of the exhaust ventilation requirements for certain industrial processes in which the principal factor controlling the ventilation needs is the rate of air displacement established by the process itself. As an example, the discharge of crushed rock through a chute onto a belt sets up a flow of air with the falling material and the air escaping from the point of feed onto the belt disperses dust into the surrounding atmosphere. The rate of exhaust ventilation at this point must be in excess of the rate of air displacement. The

*High rates of CO_2 feed (75 gms. per minute and more) through the pressure-reducing valve causes freezing in the valve. The use of a heating element near the reducing valve helps.

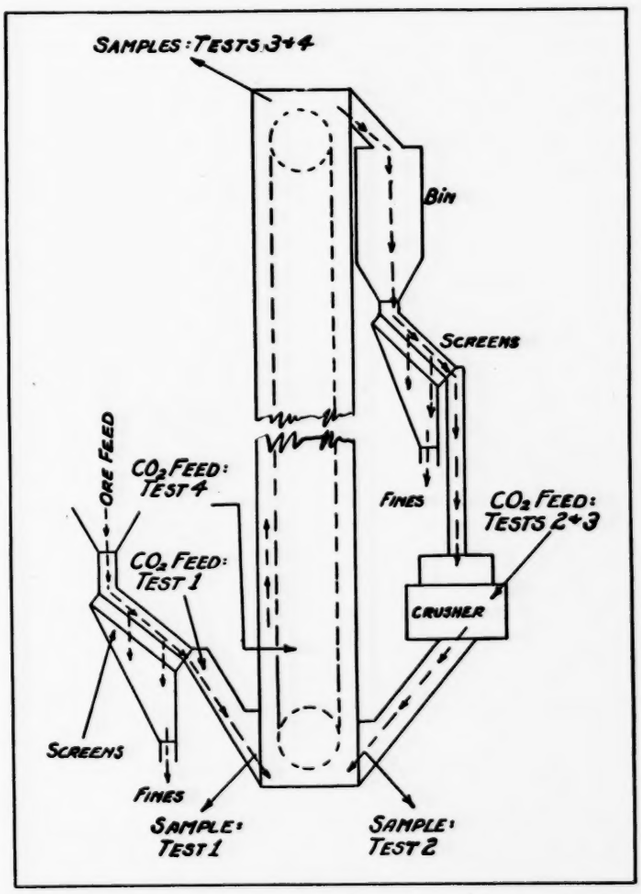


Fig. 3. Diagrammatic layout of ore processing equipment showing application of dilution method for air flow measurement.

latter can be measured by the dilution method, thus providing a basis for the design of the exhaust hood. The convenience of this method of measuring air flow rates is well illustrated by the example shown in Fig. 3. As indicated in the sketch, crushed rock was fed into the boot of an elevator through two chutes, one from primary screens and the other from a crusher. The material discharged from the elevator into a closed bin from which it was fed to screens, the oversize from which dropped through a bin and chute to the crusher. The problem was to determine the rate of air displacement in the elevator. Smoke tests revealed that air was entering the boot of the elevator with the rock discharging from the primary screens and from the crusher as well. Above the elevator boot the housing was found to be under pressure with air escaping at the elevator head and at intermediate openings. Four air flow measurements were made at the locations shown in Fig. 3. By means of tests 1 and 2 the rates of air flow induced by the discharge of rock from the primary screens and the crusher respectively into the elevator were determined whereas tests 3 and 4 were designed to measure the total rate of air displacement in the elevator. Since the major air inflow occurred in the screen and crusher discharge chutes, it was expected that the sum of the rates of air flow determined in tests 1 and 2 would approximately equal that obtained in test 3. The results from tests 3 and 4 would be in substantial agreement provided there was no leakage in the elevator housing below the point of CO_2 feed in the latter test. The rates of air flow were found to be as follows:

Test	Rate of Air Flow, CFM
1	1810
2	2750
(1 + 2)	4560
3	5000
4	4600

In view of the fact that the rate of flow of ore was not constant during these tests, the agreement among the results is excellent.

Acknowledgment

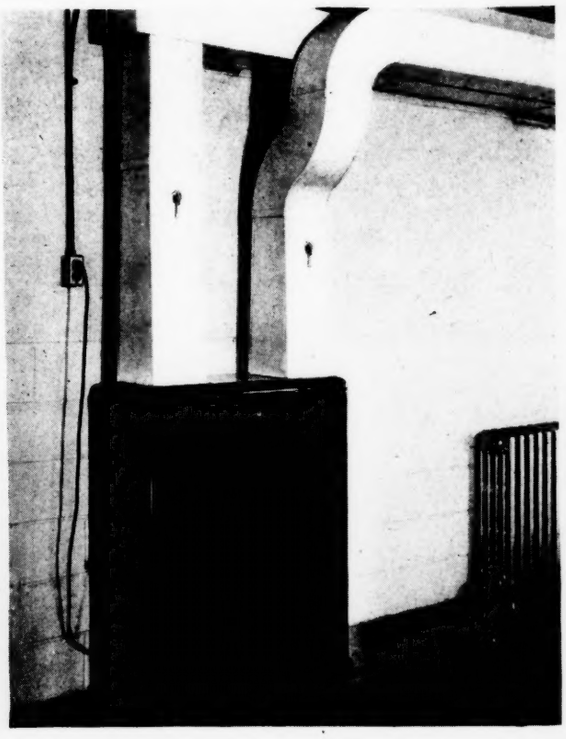
The apparatus and procedure here described were developed in connection with a fundamental study of the design of industrial exhaust systems which is being conducted by the authors, funds for which were provided by the Industrial Hygiene Foundation, Inc., and the American Air Filter Co. Their support is gratefully acknowledged.

Orchids Grown in Cleaned Air

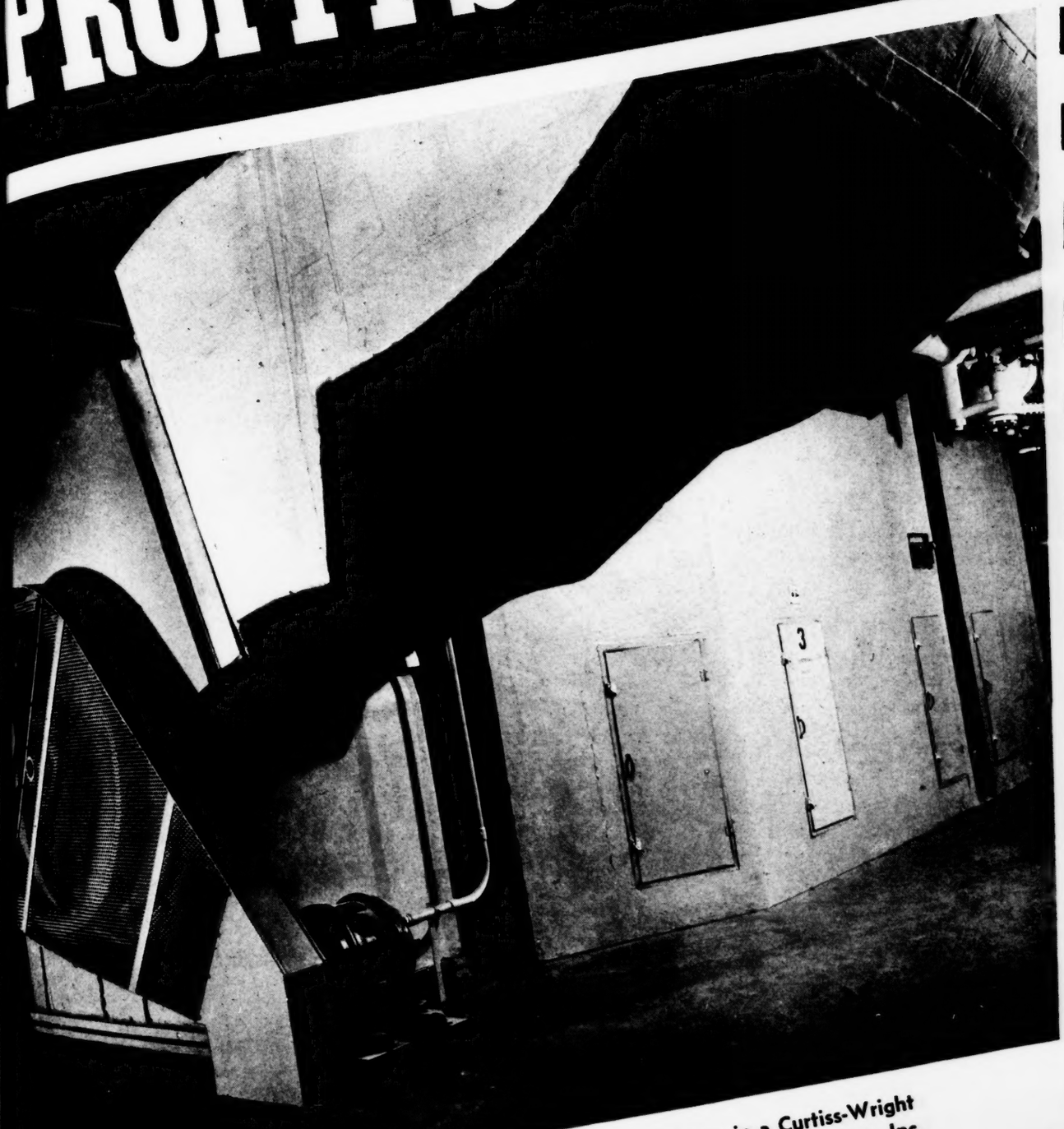
Orchid growing involves not only long periods of time (it takes from seven to ten years from the time the seed is started before a blossom is obtained) but careful control of operations. In view of these two factors it is important that a high percentage of seeds should be successfully brought to the flowering stage.

On the theory that mold and bacteria ride on particles of dust as carriers, Yohler and Mitchell, Carmel, Ind., orchid growers, have recently installed an electrostatic air cleaner, a Precipitron, in their planting room which filters the air at a rate of 240 cfm. It is expected by the company that the results of this unit will be seen in even finer quality blossoms due to the improved health of the plants and an increased yield.

(Below) J. K. Lilly, president of Yohler and Mitchell, growers of the Stephen Foster orchid, is shown in the company's laboratory, the air in which is cleaned by the Precipitron (right).



PROFITS IN AIR



This fan room is part of an essential air conditioning system in a Curtiss-Wright plane plant designed by Albert Kahn Associated Architects and Engineers, Inc.

HOW INDUSTRIAL PLANTS PROMOTE PROCESSES BY CONTROL OF AIR CONDITIONS

FOODSTUFFS

ORDNANCE

CHEMICALS

AIRPLANES

FOUNDRIES

TOBACCO

TEXTILE

BAKERIES

ELECTRICAL

FILMS

INSTRUMENTS

GLASS

MACHINE SHOPS

PHARMACEUTICAL

PLASTICS

PAPER

RUBBER

PRINTING

PROFITS IN AIR

MINNEAPOLIS SHOW CASE MFG. CO.

prevents condensation in space between show case windows by chemically dehumidifying air before it is sealed between the panes.

By MILTON FIGEN

CONDENSATION of moisture between the glass windows of refrigerated show cases defeats their very purpose—that of attractive display.

Show case manufacturers, in efforts to solve this problem, have spent considerable sums of money in placing absorbents and chemicals between the layers of glass. But such solutions have not proved effective. A second approach to the problem is that of sealing the several layers of glass in a very dry atmosphere and thus preventing at the source the enclosing of moisture which might give later difficulty.

One firm to utilize the latter method is the Minneapolis Show Case Mfg. Co. which has installed a simple stationary-bed silica gel dehumidifier, of a 600 cfm capacity, in a special insulated glazing room built for that purpose. The room, with windows triple-glazed to prevent infiltration of moisture, is 10 ft wide and 30 ft long, with an 8 ft ceiling height. Design conditions called for holding the dew point of the air introduced into the room to a dew point a little below that corresponding to the lowest temperatures to be maintained within the show cases. Specifically this meant holding the room to a moisture content of around a 30F dew point, or about 24 grains of moisture per pound of dry air. The installation met these conditions satisfactorily, with no effort being made to obtain accurate control of the temperature within the room which is simply kept within reasonable limits by means of a dry air cooler in the dry air stream entering the room. This cooler is fed with city water.

The outer walls of the room are insulated with 2 in. corkboard and the inner walls with 4 in. of rock wool. The inner walls are faced with sheet steel.

The dehumidifier, located just outside the room, is equipped with air dampers which control and reverse the air passage so that one side of the machine dries the air while the other side is being reactivated. The shifting is accomplished by means of a damper motor operated by a cycle timer. The dehumidifier, gas-fired, uses 60,000 Btu per hr for continuous operation.

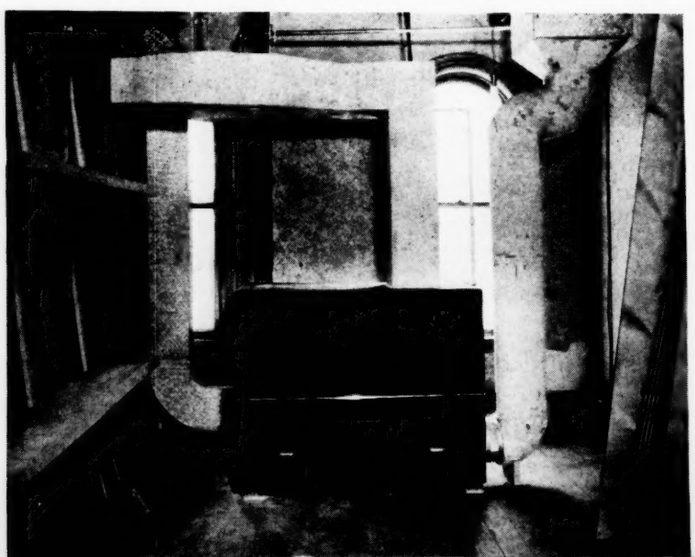
The dry air is fed into the glazing room high at the rear and is exhausted low at the front. Most of the air is recirculated, only sufficient outside air being introduced to overcome leakages and in order to maintain a positive pressure within the space. The outside air, not over 100 cfm, is sufficient for ventilation purposes for the two or three men who work in the space at one time.

Although outside summer temperatures around Minneapolis frequently exceed 100F, the temperature in the glazing room never exceeds 83F with only the tap water for cooling.

The room is not in constant use. Therefore it is unnecessary to have the dehumidifier in operation at all times. It is generally started up by hand a half hour before glazing work is to begin. When the room is used for long periods it is placed under automatic control of a humidistat.

The installation was handled through the Bryant Air Conditioning Corporation, Chicago.

The 600 cfm silica gel dehumidifier for drying the air sealed between the show case panes in the manufacturing plant. The air is dried to 24 gr per lb of dry air.



The room where the cabinet show case panes are assembled. The space is air conditioned so that the air imprisoned between the panes is dry.

PROFITS IN AIR

Syracuse Post-Standard

installs exhaust ventilating system in pressroom to provide healthful conditions for employees. Filters prevent flying ink particles from coating the ductwork and fan.

By DOUGLAS McCLURE LYON

TO facilitate drying, printing inks contain, as the vehicle, a combination and variety of volatile substances. When these inks are run on high speed presses, whose ink rollers revolve at corresponding high speeds, a portion of the ink is continuously thrown by centrifugal force into the air in the form of invisible particles whose presence can be detected by the characteristic odor of the ink and, as time goes on, by the accumulation of these particles in sticky masses on the surfaces where they are thrown.

In the summer of 1940 the Syracuse (N.Y.) *Post-Standard* moved into its newly-modernized two-story building at the corner of East Fayette and Montgomery Streets, Syracuse. The modernizing consisted of a new terra-cotta facing, complete new interior, and other structural changes, as well as the installation of a new Hoe printing press, located in a pressroom 27 x 72 ft in the center of the rear portion of the building, which has a height of two stories. The new press has a capacity of 240,000 papers per hr of four to twelve-page editions or at decreasing rates for larger editions to 60,000 per hr of 48-page editions.

As a safeguard for the health of the pressroom employees an exhaust ventilating system was provided for in the plans of the consulting engineers, Robson & Woese. This system consists of streamlined ductwork with a capacity of 4000 cfm, the air being exhausted by a Buffalo Forge fan.

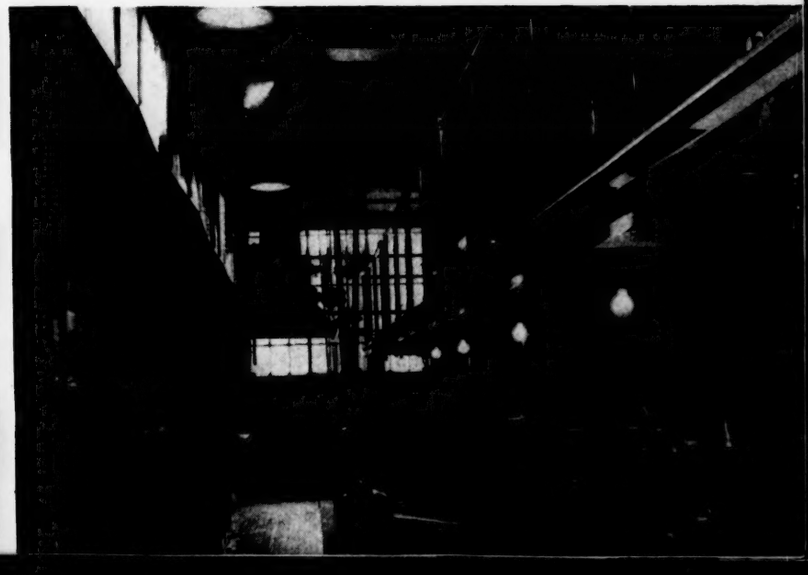
In designing this exhaust system it was necessary to take into account the flying particles of ink previously mentioned for obviously if this ink were to collect in the ductwork or on the blades or housing of the fan periodic cleaning of a very difficult character would be absolutely necessary. Added to this the solidified ink which would collect on the inside of such ductwork would constitute a very serious fire hazard. In order to meet this situation the consulting engineers provided air filters placed at eight equally spaced points in the ductwork so that the ink could be collected and easily removed. For this purpose eight 20½ × 20½ × 2 in. holding frames, each carrying a 20 × 20 × 2 in. Air-Maze Ink-Stop filter, and with a total filter surface area of 3200 sq in., were installed by Peter L. Cooper, the heating contractor.

These filters are cleaned once each month by the *Post-Standard's* maintenance man. They have been in continuous operation since the summer of 1940 and no traces of ink in the ductwork or on the fan have been found.

The building is steam heated. The heat is distributed to each office or room in the office portion by unit ventilators thermostatically controlled, also equipped with Air-Maze filter for cleaning not only the outside but the recirculated air. These are cleaned periodically by the maintenance man.

Architects for the project were M. L. and H. A. King; consulting engineers were Robson & Woese; heating contractor, Peter L. Cooper, all of Syracuse.

(Left) The newly modernized building of the Syracuse Post-Standard. (Right) Pressroom of the Syracuse Post-Standard. Ink-Stop filters are located in the ductwork shown in the upper left.



PROFITS IN AIR

Reliance Electric & Engineering Company

improves its rotor casting department at Cleveland, uses a 10,000 cfm exhaust fan above casting presses and additional exhaust fans for removing process heat.

THE rotor casting department of the Reliance Electric & Engineering Company, Cleveland, has been substantially enlarged as part of a recent expansion program. In addition the department has been moved to new quarters adjacent to the motor assembly department. In the rotor casting operating the rotor bars, short-circuiting rings and fan blades of motors are produced as an integral section. Laminations for the rotor core are stacked on arbors, assembled into molds and put under pressure in casting presses. In some cases the laminations and molds are preheated before being put in the casting presses. In the casting operation, molten aluminum at 1250 to 1420F is poured into the press, the mold is moved into position, the safety hood of the press closed and the hot metal under several tons pressure forced up into the mold. One press is air operated, the other hydraulically operated.

The problem of securing good ventilation for the department was given special attention and provision made for changing the air as frequently as three times a minute, if desired.

A ventilating hood, 6 x 6 ft, equipped with an exhaust fan capable of handling 10,000 cu ft of air per min, was installed directly above the two casting presses. Motor-driven blowers in vent pipes force the fumes from the casting presses up into this exhaust hood which, in turn, discharges them through a stack.

Two exhaust fans, driven by 1½ hp motors, mounted along the wall on either side of the hot metal ladles, are used to remove the excess heat present during the warm summer months when the building doors are open. They discharge through shuttered apertures in the steel sash of the building's side wall.

Fan enclosures, shelves for the motors, and supporting frames, have all been made from sections of steel plate and welded together. The vertical channels between which the fans are mounted are anchored at floor and ceiling, but kept separated from the walls and steel sash to hold to a minimum noise and vibration.

A separate vent line and motor-driven exhaust blower serve the preheating oven, discharging directly to the outside of the building.

(Left) The ventilating hood for the casting presses is shown at the upper left. This hood is equipped with an exhaust fan to remove fumes from the presses and discharge it through a stack. (Right) Exhaust fans along the wall for carrying away excess heat from the hot metal ladles during summer months.

The Application of Organic Amines to Steam Systems

By M. E. DREYFUS
Vice-President, Western Chemical Co., Kansas City, Mo.

The author describes a process of introducing organic amines into a steam heating system in order to neutralize acidity in the steam and condensate and thus reduce or eliminate corrosion. The method is under observation by various engineering society committees on corrosion; comments on experience with this method are solicited.

IN his comprehensive work "Corrosion—Causes and Prevention," in the chapter on the prevention of corrosion in heating systems, Dr. Frank N. Speller makes this statement: "A suitable volatile alkaline compound should be useful when added to the boiler to neutralize any acidity in the steam."

This statement was the inspiration for an investigation which developed a process of applying organic amines to steam systems. This process, which is patented, consists briefly of the introduction of organic amines having certain physical and chemical characteristics into any part of a steam system. The amines employed are characterized by being soluble in water, having an alkaline reaction, and having such volatility as to vaporize with steam and condense with steam. Consequently, such amines, when fed into a boiler, will appear in solution in the condensate in all the numerous and distant zones of condensation. The condensate will become alkaline, with a pH determined by the concentration and character of the particular amine used.

The class of organic compounds known as amines may be considered as hydrocarbons or other carbon compounds in which one or more hydrogen atoms have been replaced by the amino group NH_2. On the other hand, and arriving at the very same final product, amines may be considered as ammonia in which one or more hydrogen atoms have been replaced by a hydrocarbon or other carbon radical. These relationships are mentioned solely to illustrate the molecular structure of amines.

It must be remembered that such substitution of radicals profoundly alters the physical and chemical character of compounds, and an amine is not to be identified in properties either with ammonia or with its corresponding hydrocarbon. It should also be emphasized that the alkalinity of amines is an inherent property and does not result from decomposition.

The alkaline character of water soluble amines enables them to impart alkalinity to water solutions, to raise the pH of these solutions in proportion to the concentration and the nature of the individual amine used and to neutralize acids. They will, accordingly, react with carbonic acid and form well defined salts.

It is the additional property of vaporizing and condensing with steam that permits suitable amines to contact the entire vapor and condensate zones when introduced at one point such as the boiler; to create and maintain a desired pH in the condensate at all the numerous points of condensation and beyond; and to return to the boiler with the condensate for revaporization and recirculation.

It is not within the scope of this paper to present in full the development of the theory of corrosion as it relates to steam systems. It is, however, of advantage to mention briefly those generally accepted views on the nature of corrosion which relate to the use of suitable organic amines in steam systems and explain their action.

While this discussion will be elementary to many, it is necessary to emphasize the fact that acidity promotes corrosion. It is with no thought that anything new is presented in this discussion of theory; but without it the importance of oxygen as a factor in corrosive action might obscure the importance of acidity. The function of amines is to neutralize acidity and to raise the pH of condensate, thereby retarding corrosion in the presence of oxygen.

When iron is placed in contact with pure water having a pH value of approximately 7, it tends to go into solution, displacing the hydrogen ions which are available due to the ionization of pure water. This anodic action follows from the relative position of iron and hydrogen in the electomotive series of the elements. The products of the reaction are ferrous hydroxide in solution and hydrogen, either evolved as a gas or adhering as a film in atomic form to cathodic areas. This process is referred to as initial corrosion.

When the aqueous medium is not neutral but is in an acid condition, the hydrogen ions are present in a greater concentration than in pure water, as measured by a pH value lower than 7. The greater amount of hydrogen ions thus available permits iron to displace them more readily. Hydrogen is evolved more freely. In acid solution, therefore, corrosion is accelerated.

On the other hand, when the aqueous medium is alkaline, as denoted by a pH value higher than 7, the hydroxyl ions are present in excess and the concentration of available hydrogen ions becomes increasingly small. As the point is approached where there are no longer sufficient hydrogen ions present to maintain the reaction, the rate of displacement decreases. This is the basis for the fact of common knowledge that alkalinity retards corrosion.

Ferrous hydroxide, already mentioned as one product of the corrosion reaction, itself provides hydroxyl ions in solution in increasing amount as its own concentration increases. The theoretical point beyond which

iron does not dissolve in pure water is the pH value corresponding to the alkalinity provided by a saturated solution of ferrous hydroxide. This pH value was formerly considered as 9.6. However, the recent work of Finnegan and Corey shows that figure to be influenced by experimental error, and the correct value to be about 8.3.

Another limitation on the progress of initial corrosion is the formation of the film of hydrogen on the cathodic areas. When this film tends to blanket such areas, its rate of removal becomes the controlling factor in the rate of corrosive action.

So far only the ideal situation of iron in pure water has been considered. Under practical conditions, the presence of oxygen in greater or less degree is a usual factor. The importance of oxygen is that it removes both of the limitations on the progress of initial corrosion.

Dissolved oxygen combines with ferrous hydroxide, oxidizing it to the ferric state, in which it is practically insoluble. The ferric iron precipitates from solution combined with the excess hydroxyl ions, permitting the return to the lower pH value of pure water. Furthermore, dissolved oxygen combines with the atomic hydrogen, oxidizing it to water. This depolarizes the cathodic areas by removing the adsorbed film, and the corrosive action proceeds.

Thus it is seen why oxygen is an active factor in the maintenance of corrosion in pure water. However, in strongly acid water the greatly increased hydrogen concentration neutralizes the hydroxyl ions as formed, and also promotes the evolution of hydrogen. Consequently, at low pH values maintained corrosion does not require the presence of oxygen.

The only acid normally present in steam systems is carbonic acid, formed by the solution of carbon dioxide in water. Carbonic acid is a weak acid from the standpoint of its degree of ionization. It does, nevertheless, provide ample hydrogen ion concentration to promote acid corrosion. In an unbuffered solution of carbon dioxide at 20 degrees C, the theoretical pH value is about 4.5 at 100 parts per million of carbon dioxide, and is about 5.9 at a concentration of only 2 parts per million.

According to the theory developed by Collins and Henderson, at a pH value of 5.9 and below, corrosion will proceed at the same rate as in a solution of mineral acid of the same hydrogen ion concentration. This condition would prevail in and near the zone of condensation, with freshly formed condensate containing 2 or more parts per million of carbon dioxide. When the pH value of the condensate rises above 5.9 due to the increasing quantity of dissolved iron present, corrosion will continue in the presence of dissolved oxygen

The carbon dioxide and oxygen, which singly or together are the fundamental causes of corrosion in steam systems, must be in solution for their corrosive action to take place and only such amounts of these gases as are dissolved in the condensate will be active. Consequently, corrosion will occur chiefly in zones of condensation and beyond, where the metal is in contact with condensate.

Hall and Mumford have pointed out the distinction that must be made between the character of the steam itself, including all gases in it, and the character of the condensate formed from and in contact with that steam. If less than half the entrained carbon dioxide in steam will dissolve in the condensate formed in contact with it, then more than 5 parts per million of carbon dioxide would have to be present in the steam to form a condensate having more than 2 parts per million. However, such carbon dioxide content in steam is readily exceeded in practice.

The two sources of oxygen and carbon dioxide in steam systems are the steam itself and the atmosphere. The principal source of carbon dioxide is entrainment with the steam. Infiltration of air is the chief source of oxygen in the condensate.

Collins and Henderson have stated that most pipe failures occur in condensate lines immediately adjacent to zones of condensation where no infiltration could occur and only entrained gases could be dissolved in the condensate. At such points carbon dioxide is the controlling factor; and with a concentration of over 2 parts per million and sufficient flow, corrosion could be serious.

Speller also refers to the corrosive attack on horizontal return lines in such zones. These lines show a clean cut groove in the lower side of the pipe wall with very little rust formed, thereby indicating acid corrosion. Speller mentions particularly the corrosive damage that can be done to metal in contact with condensate by a small amount of carbon dioxide in closed steam systems where practically all the steam is condensed and returned to the boiler.

In those parts of a steam system operating intermittently or continuously at pressures below that of the atmosphere, the infiltration of air provides unlimited quantities of oxygen which, when dissolved in the condensate, becomes the controlling factor in corrosion in such zones. Corrosion where oxygen is the controlling factor is typified by the formation of rust deposits which collect at restricted points, obstruct lines, reduce heat transfer, and interfere with the operation of traps.

To combat both types of corrosion an alkaline agent is indicated. Such an agent would neutralize carbonic acid and raise the pH of the condensate so that corrosion is prevented or retarded in either the presence or absence of oxygen. Heretofore, the obstacle has been to obtain such an agent that would maintain intimate contact with the steam and condensate, circulating continuously with them and reaching all zones requiring protection, however remote from the point of application. As Dr. Speller said, "A suitable volatile alkaline compound should be useful."

Such an agent, consisting of suitable organic amines, is now available under the name of Coravol.

It is readily granted that the Coravol process is not universally applicable. It is not indicated in those plants which are already taking advantage of the long established methods for producing a non-corrosive steam and condensate, providing, of course, that water and operating conditions are such as to permit those methods to be effective. Such methods would include lime and soda softening, a deaerating feedwater heater,

deoxidizing chemical treatment, ample condensate storage capacity, an air-tight system. Additional requirements would be chemical control, trained personnel, a natural feedwater of suitable quality, continuous rather than intermittent operation.

Plants where several or all of these conditions exist are, as a class, the largest. There would remain then the vast majority of steam plants, small or medium sized, according to the standard of comparison, as well as plants already employing several of the methods just mentioned without efficient performance. To such plants the application of amines can be considered in the light of the individual need.

A typical example is that of a hospital with 15,000 sq ft of radiation. In this steam plant failures in the piping began to appear about a year after completion of the building and continued with increasing frequency. The feedwater containing about 140 parts per million of temporary hardness was put through a zeolite softener, thereby converting the calcium and magnesium bicarbonates to sodium bicarbonate, which readily decomposed in the boiler, yielding large quantities of carbon dioxide to the system. Condensate was in an acid condition and contained 12 parts per million of carbon dioxide. Examination of piping showed the typical grooving action of acid corrosion. The use of amine treatment is producing an alkaline condensate and deterioration of the piping appears to be arrested

In practise, the treatment is fed directly to the boiler in relatively heavy initial doses. An alkalinity test using phenolphthalein indicator and N/50 sulfuric acid solution is made on samples of condensate at intervals determined by the size of the system and the rate of circulation. After alkalinity has been established throughout the system, the dosage is adjusted so that the alkalinity is maintained as uniformly as practical within the desired range. Samples of the condensate for testing are taken at a point where it is typical of returns coming from the system. Obviously, it must contain no make-up or boiler water.

Loss of steam and condensate from a treated system causes a corresponding loss of the amine they contain. Consequently, the smaller this loss is, the less treatment is required to maintain the alkalinity. Furthermore, the equivalent amount of make-up water that is added would usually contribute some additional carbon dioxide to the system, requiring further neutralization. It follows, therefore, that other things being equal, as the percentage of condensate increases, the amount of amine required decreases and is at a minimum in a completely closed system. However, the real measure of the possible value of the process in any given case is in terms of preservation of equipment, efficiency of operation, and character of steam service secured per day or per year.

Reference is made to one plant having 60,000 sq ft of radiation with a relatively high loss of condensate, perhaps as much as 25%. Amine treatment is used and a corrosive condition that was continually clogging lines, traps, radiators and valves appears to have been relieved.

Similarly, there is the case of a 27-story office building containing 800 radiators and with approximately 25,000 sq ft of radiation. The amount of make-up water is exceedingly low. Amine treatment is correcting a previously existing corrosive condition.

In the steam system of an insurance company home office building with the same radiation, 25,000 sq ft, a new plant, amine treatment is used solely as a preventive measure.

Condensate returning to the boiler carries with it the product formed by the reaction of the amine with carbon dioxide. If there is present in solution in the boiler water a non-volatile basic treatment such as is commonly used to raise the pH of the boiler water itself and to protect the evaporative surfaces of the boiler, then the carbon dioxide combined with the amine will remain fixed in this stronger base solution. The amine component will return to its free form for recirculation.

Since the particular pH range within which the condensate is maintained can be readily controlled, it becomes a matter of choice for the plant operator. It would not be of advantage, however, to keep the range higher than is necessary to secure the desired results. In practical use, quite satisfactory results are obtained by holding the pH within a narrow range having a minimum value of 8.4. At 8.4, as determined by phenolphthalein indicator, all free carbon dioxide is neutralized.

Since the amines used are liquids at atmospheric pressure and temperatures and their vapors are readily condensible, there is no possibility of an accumulation of the vapor in dead ends or in other spaces of poor circulation.

Soon after the amine process was put into practical application, reports began to be received regarding an observed action on old rust deposits previously formed. A typical such report is as follows:

"Previously the walls of the condensate return lines were heavily coated with dark red rust. Since the use of the treatment the lines are approximately 70% free. This was found by examination while remodeling the heating system. It is also noted that there is an increase in heating efficiency due to cleaning out the pipe coils, radiators, and the system in general."

No theory is put forward at this time to explain this action of rust removal but it has been observed and reported too frequently to be disregarded.

Practical benefits observed as resulting from this action include the following. Traps are cleaned and restored to efficient operating condition. The clogging of pipes by rust deposits is eliminated. Sluggish radiators are rendered more active. Steam circulation is improved.

And in conclusion, here is the case of the system to which Coravol was first applied on a full scale plant basis. This steam system serves two civic office buildings with about 40,000 sq ft of radiation. Formerly corrosion was active. The condensate lines were channeling. Replacement of pipe and fittings was frequent.

Coravol has been used continuously in this plant since November, 1936. At intervals since then it was found that no channeling was occurring and in September, 1941, it was reported that no replacements had been necessary during the past three years.

Theory Vs. Practice

Radiator Sizing and Changes

By T. W. REYNOLDS

IN casting about as to what to do and where to start in altering an unsatisfactory heating plant one should not add radiation in each room as called for by calculations without thinking the matter over carefully. Rooms with southern exposure are usually satisfactorily heated, all figures to the contrary, and most bedrooms and sun porches are not so important as the living rooms, while in many cases some of the radiators can be interchanged to suit the individual requirements of certain rooms. In any event, a radiator should never be replaced just because it is short by a few square feet of heating surface.

The writer knows of one house where the bedrooms on the third floor had radiators considerably below size as ordinarily computed, yet these rooms were satisfactorily heated from the heat which rose from the first floor up a large open stairwell. Another case in mind was one where not only the radiators were below accepted sizes, but also the boiler and oil burner. A contract was let for the purpose of bringing all equipment up to requirements and following the usual schedule the boiler and burner were first removed and replaced with those of proper size. The burner was then started coincident with some of the coldest weather and it was discovered that all of the rooms could be satisfactorily heated in spite of the fact that as yet no radiator changes had been made.

The additional heat effect of any exposed distributing risers should be taken into account before making any radiator changes. For example, some large living rooms may have as many as four such risers in the room with a total of about 14 sq. ft. of surface, which may be near enough in quantity to be considered sufficient for the additional required heating of the room. The heat effect of such risers is generally ignored in making heating calculations for a new heating plant on the basis that any additional heat effect operates as a factor of safety and as a quick pick-up. Upon occasion, this heat effect should be taken into account because exposed risers are sometimes the cause of throwing a heating system out of balance by overheating the room they are in; in other cases, underheating results in rooms without risers where the thermostat is in a room with risers. Objection is sometimes made as to placing any reliance on the heat effect of risers, as these may become air bound and cold if radiators on an upper floor are valved off, but this seldom happens. Exposed risers will continue to heat a vacated apartment if the apartment above it is occupied.

When adding radiation to a building, it is more satisfactory and usually cheaper, considering the labor involved, to substitute new radiators of larger size for the old radiators rather than to add sections to existing radiators which are generally old types of poor appearance and quite apt to leak when disturbed. The new radiators of increased size can be those with sections on 1½ in. or 1¾ in. centers so that no more space need be taken up than before. When more space is required it will mean the taking up of the floor for two connections on radiators for hot water or vapor systems and one connection for radiators on one pipe-steam systems if the radiator must remain centered on the window. In such cases it is better to substitute a radiator of a size to fit the physical conditions, even though it may be a radiator of one or two sections less than calculated.

Many bath rooms, due to limitations of space, contain a radiator of insufficient size which is expensive to replace considering that a tile floor may have to be disturbed for new connections to fit the new radiator of increased size. A new runout or runouts may be run on the floor to former floor connections, but runouts on the floor are neither clean nor neat. Where the radiator is located on an inside wall it is quite likely that the concealed floor runout is run outside of and along the bath room wall in the adjacent room, in which case new floor connections can be more easily made to fit a new and larger radiator and with much less disturbance of the tile floor than would otherwise be required.

Sometimes it is unnecessary to add capacity to radiators of only a few sections, such as those in small bath rooms, even though the figures indicate otherwise. This is due to the large amount of heat radiated from the end sections of a radiator as compared to the heat from intermediate sections where reentrant rays restrict the output. For example, a two-section three-column or five-tube radiator 38 in. high rated at 5 sq. ft. per section (a type commonly used in small bath rooms) actually has a heat output which is greater by 20% than its rating—in other words 6 sq. ft. per section.

SAVING FUEL . . . FOR HEATING

by John F. Collins, Jr.

HEATING AND VENTILATING'S REFERENCE SECTION

5

SAVING FUEL IN HEATING

By JOHN F. COLLINS, Jr.

Secretary, National District Heating Association

With the Nation at War, there is a greater interest than ever before on the part of the Government, organizations and individuals in the saving of fuel. With oil tankers being sunk along the Eastern Coast, with coal miners, gas workers and others seeking more lucrative employment or being taken into the armed forces, something more than interest must be shown—something must be done. Fuel must be saved or our buildings, at least in some areas, will be cold and uncomfortable next winter. The purpose of this Reference Section is to summarize practical information on Fuel Conservation so as to meet the conditions to be faced next winter.

The procedures suggested for saving fuel summarized in the material which follows has been prepared primarily for the larger buildings, although many of the ideas are applicable to smaller buildings. Since most large buildings are heated with steam the discussion of the systems themselves has been limited to steam heating systems.

There are six steps, most of which can be carried on simultaneously, in a scientific investigation and improvement program to decrease heat use and loss and therefore to produce a fue saving in a building. These steps are

1. Search to obtain all available records and information as to heating and prevailing conditions affecting heating.
2. Make a heat loss survey of the building; this consists of measuring from plans or from the structure itself the area of each exposed surface and the length of each crack or opening through which air can enter or escape. From these and other known or determinable facts about the weather and the heat loss, an estimate of the heat actually required per normal year is obtained;
3. Examine the building structure to learn its deficiencies from a heat saving viewpoint and the improvements that are economically feasible;
4. Examine the heating system and temperature control equipment to determine the adequacy of the system to replace the heat lost to find out its faults and condition of repair, all with the purpose of making improvements found necessary and economically feasible;
5. Make improvements to buildings and system as found desirable; and
6. Train and stimulate with enthusiasm the building personnel so as to operate the building and its system according to the best principles for economical heating. By building personnel is meant not only the building superintendent, chief engineer and his assistants, if there are such officials, or the janitor if he looks after heating, but the scrub women as well, all of whom have an important roll and can help or hinder any effort at fuel saving. In this emergency the tenants might also be asked to aid, for their own comfort, and HELP SAVE FUEL signs might be put in the hallways beside air raid instruction signs.

Many will find it possible to save fuel by taking only steps 3 to 6, inclusive, but they may not know how well they are succeeding.

The author acknowledges the very helpful advice of various members of the engineering staff, Allegheny County Steam Heating Company, Pittsburgh, in the preparation of this Reference Section.

1. RECORDS AND DATA

A record of past performance is sought simply as one of several means of judging how much saving in fuel may be expected from the proposed alterations and more efficient operation. Based on his knowledge of the heat consumed in a past period of as much length as possible for which the weather and conditions in the building affecting its heating needs are known, a trained utilization engineer, such as is in the employ of utilities and municipalities furnishing steam, hot-water, or gas, and by manufacturers of heating and temperature control equipment, can estimate how much fuel should be needed in a building of any classification when improved and operated carefully.

In many cases the effort to obtain actual operating figures may be a disappointment as it will be found that the records have not been taken or preserved. However, a search will at least uncover enough information as to careful or careless operation and repair or lack of repair in the building and its heating system as to make it worthwhile.

The figures which are most needed are those on:

(1) Fuel used during a known period of months or years, if possible; (2) Degree-days or daily mean temperatures for this period; (3) Building volume; and (4) Amount of radiator surface.

Fuel Use

If the building personnel were keeping a record of fuel use per day, that would indicate some appreciation on their part of the desirability of careful operation. Usually the figure that can be obtained is not this one but the quantities that have been bought at various times and the dates of purchase. If the building does not have these data, they may be obtained sometimes from the seller of the fuel. Giving due consideration to the fuel storage capacity in the building, if solid or liquid fluids are being burned, an estimate of use for a given period can be made.

Degree-days

To use in conjunction with the fuel consumption total, it is necessary to obtain or compute the degree-days for the period. If there is a local U. S. Weather Bureau office in the immediate vicinity, the meteorologist probably can furnish daily mean temperature records from which the daily degree-days and their total for the "record" period can be computed. Monthly mean temperatures can be used in place of daily mean temperatures only for months in which there has been no day with a daily mean temperature above 65F without introducing an error. If there is a district heating utility or a gas company near the location of the building, they very probably can furnish the record of daily degree-days for the period, making it unnecessary to compute them.

Heating Building Volume

The method to be used in figuring the volume of a building for heating

purposes from its dimensions is something which unfortunately heating engineers have not been able to agree upon to date. All include the heated air space. Where they differ is in the inclusion or exclusion of areas without heating equipment such as basements and of parts of the structure such as exterior walls, partitions, columns, floors and roof. These items are such a considerable percentage of the whole gross volume that one engineer including them might arrive at a volume figure of twice that which another might get, excluding them. It becomes essential at present until a standard is agreed upon, when a building volume is given, to state what features are excluded from the gross. The author can state with positiveness that in spite of the difficulties mentioned the volumetric basis is a very excellent one for comparing annual fuel requirements.

Radiation

Those engineers who prefer the radiation method of comparing fuel use to the volume method, must know the amount of installed direct radiation and the additional amount of direct radiation to which any indirect radiation in place is equivalent. These two figures added together are the equivalent direct radiation (EDR) in the building. There are also peculiarities to be considered in using the radiation method of comparison as some buildings are over-radiated. Radiation is covered more fully later, under Step 2.

How the data obtained are used is indicated by the equations:

$$\frac{\text{Total fuel use}}{\text{Total degree-days}} = \text{Fuel per d.d.}$$

Fuel use per d.d. × d.d. per normal year = Estimated fuel use per normal year

$$\frac{\text{Fuel use per d.d.}}{\text{1000 cu ft vol.}} = \text{Fuel use per d.d. per 1000 cu ft of volume.}$$

$$\frac{\text{Fuel use per d.d.}}{\text{Sq ft EDR}} = \text{Fuel use per d.d. per sq ft EDR.}$$

Building Conditions

Certain conditions about a building are important factors in the fuel use. Inside temperature, number of occupants, and kind of activities carried on are important. Some additional ones are suggested below.

Old buildings ordinarily will require more heat than new ones. Age is, therefore, a factor. More is now known than formerly about how to build structures to save heat. Also it might be expected that there would be more air leakage in old buildings as weatherstripping often was not installed and if in place it may have deteriorated.

Age, condition, and changes made in the heating system are important.

Buildings described as *office buildings* often are more exactly *bank-office* buildings, *store-office* buildings, etc. Unless the heating system was designed to permit the shutting off of heat in parts when unoccupied while others are in use, the areas occupied at odd-hours, such as restaurants, doctors' and dentists' offices, and stores with night hours will play an important part in fuel requirements.

Other factors of interest are:

(1) Whether the building was overheated generally or in places, all the time or occasionally during the period of record; (2) Whether there were difficulties, such as leakage, no heat or underheating generally or locally, all the time, or occasionally; (3) What the usual hours of occupancy were; (4) What percentage of the occupiable space was in use; (5) What other considerable sources of heat there were if any; (6) Whether the windows were opened by tenants occasionally or generally; and (7) What apparent skill and enthusiasm were shown by the operators. For use in assembling the records indicated above, Form A is suggested. (See next page).

2. HEAT LOSS SURVEY

This is the estimating of the heat lost from each individual part and room in a building, and from the building as a whole, by transmission and by infiltration.

Why Made

Such surveys may be made to find out how much heat a building, as it is, requires for space heating, if well operated; how much, after improvements are made, if operated in the same way and, therefore, how much heat saving each improvement will result in, thus establishing by comparison with its cost whether each improvement is worthwhile from the viewpoint of dollars and cents. By these surveys also, it is learned how much heat will be required to maintain the desired temperatures within the building when the temperature outdoors is down to the outdoor design temperature. When the sizes of radiators needed and in place are known, it is simple to check and find whether other parts of the system, such as lines, traps, air vents and boiler or service, are properly or improperly sized.

Such facts are all of interest in the problem of saving heat. For instance, if the actual heat use has been computed per degree-day from the purchased fuel records, a comparison of this figure with the estimate of use per degree-day as arrived at from the survey will show how well the building has been operated. In order that the survey figures may be an accurate index of fuel needs, great care must be used in selecting the proper transmission coefficient for each wall or roof through which heat passes, in measuring the area of each exposed surface, and in estimating infiltration air. The knowledge that a radiator is over-sized, under-sized or proper is of primary importance in the making of changes to attain the economical use of heating fuel.

When Made

It is best to secure as much as possible of the useful information about all phases of the program in one inspection, especially if the data to be obtained are in rooms rented to tenants. It is much better to do this investigating when spaces are vacant, but if done in office hours, it is better to do the work in the summertime, rather than in the heating season. The reason for these suggestions is that persons are affected psychologically by seeing things done to the heating system. They become heat conscious and there will be a flood of complaints, mostly unjustifiable, if the work is carried on in business hours when heat is being furnished.

How Made

The work to be done may be considered under two headings — (1) examination and measurements of the building, and (2) computations of heat loss.

Sometimes surveys are made of whole buildings without regard to rooms or radiator locations. Figures derived by such computations are satisfactory in making sure that a boiler or a service is of the right size or that the building has enough radiation installed, but they do not show locations at which trouble may be expected.

It is much safer to make measurements of a building itself than to take dimensions off the plans, if they happen to be available, for the building may not have been built just as the plans show, or changes may have been made to the structure later. Plans, however, are useful as a check.

For efficiency, it is best for a surveyor in making surveys of large buildings of many rooms to have two or three assistants. The surveyor should put down on his survey sheet all the dimensions and descriptive data which his assistants observe. One man will be busy locking and unlocking doors and turning lights on and off if the survey is made at night and during hours when the building is mostly unoccupied.

Equipment needed consists of survey sheets, board with spring clip to hold sheets, black and colored pencils, 1 ft rule, knife, 6 ft rule, good 50 ft

cloth tape, and flashlight and batteries.

To obtain the transmission losses in each room or space in the building, the dimensions of each kind of surface—wall, roof, ceiling, window, door, etc., — through which heat passes from the structure must be measured and the area computed. The thickness, location and composition of each such part of the structure must be set down for later reference in selecting the proper heat transmission coefficient.

To obtain the infiltration losses, the more accurate method is to measure the feet of crack around windows and to note for later consideration all other openings and equipment, such as window fans, which will promote or hinder the passage of air into or out of the building.

To obtain the amount of direct radiation, it is necessary to take the dimensions and count the tubes and sections in each such radiator. The Btu output of each direct cast iron radiator per hour, when properly installed and filled with steam, is known. This is more fully explained under (4).

To compute the amount of direct radiation to which convector type heaters and indirect radiation are equivalent, it is first necessary to examine this equipment and then obtain from the makers or their catalogs the coefficients to use in the conversion.

When a survey is being made while heat is turned on and the space occupied, it is useful, if there is a thermometer in the room, to note the temperature it registers. Also, it is well to note if any windows are open and the kind of use made of the space.

SAMPLE HEAT LOSS COMPUTATIONS—OFFICE 10 x 18.2 x 10 FT. HIGH

Room or Space	Transmission Surface or Infiltration Location	Area, sq. ft., or Length, lin. ft.	Coefficients Btu per sq. ft. per F per Hr.	See Footnote	Temperature Diff., F	Heat Loss Btu per Hr.	Heat Loss Summary
Room 202	North Wall	72 sq. ft.	.25	(a)	70	1260	
	North Wall Window	28 sq. ft.	1.13	(b)	70	2215	
	N. W. W. Crack	26 lin. ft.	.54	(d)	70	983	983 inf.
	West Wall	182 sq. ft.	.25	(a)	70	3185	
	Ceiling	182 sq. ft.	.69	(c)	35	4395	11055 trans.
	TOTAL Btu					12038	12038
	Equivalent Direct Radiation, Sq. Ft.					50	

(a) 4 in. brick backed by 8 in. hollow tile with ¾ in. plaster on metal lath-furred
(b) Single glass
(c) ¾ in. plaster on metal lath below joists, no flooring above
(d) For foot of crack permitting 30 cu. ft. per hour leakage of air with a 10 mile per hour wind velocity, 30 × 0.018 = .54 Btu
Prevailing wind from North

Inside temperature	70F	Inside temperature	70F
Outside design temperature	0F	Space above ceiling at	35F
Temperature difference	70F	Temperature difference	35F

FORM A. RECORDS AND DATA ON PAST OPERATIONS

Name of Building ..... Search by .....
Location of Building ..... Date .....

BUILDING

Type .....
Age .....
Height .....
Ground Floor Dimensions .....
Major Changes .....
.....
.....
Kind of Fuel Used .....
District Heating Service Used .....
Fuel or Service Records furnished by .....

HEATING SYSTEM

Type .....
Age .....
Kind of Temperature Control .....
.....
Major Changes .....
.....
.....
Degree-days in normal year .....

FUEL RECORD

Period Included between (days)	Total Fuel or Service Used	Amount Fuel or Service non-htg	Fuel or Service Space Htg	Unit	1000 Btu per Unit	1000 Btu for Space Htg	D.D. in Period	1000 Btu per D.D.	1000 Btu per Normal Year

CONDITIONS DURING PERIOD

OVERHEATING
General .... Local .... When .... Where .... Est. Temp. .... Cause .....

UNDERHEATING
General .... Local .... When .... Where .... Est. Temp. .... Cause .....

Percentage of Building Occupied ..... Percentage Heated .....
Was there any other considerable source of heat? .....
Describe .....

OCCUPANCY HOURS
Weekdays .... to .... Saturdays .... to .... Sundays .... to .... Holidays .... to ....

Temperatures during occupancy ..... During non-occupancy .....
Odd hour occupants .....
System difficulties such as leaks .....
.....
Tenants opening windows .....
Other tenant peculiarities .....
Skill, energy and enthusiasm of operators .....

The securing of all this information may appear to be a difficult task; however, often it will be found that many rooms in a building are duplicates as to main features and all that need be done is carefully to verify this.

The nature of the heat loss computations for each room is indicated by the accompanying sample computation. The sum of the room or space heat losses per degree-day is the total for the building per degree-day if the building is furnished with district heating service. If boilers within the building are the source of heat, their efficiency must be considered and an additional allowance made when computing fuel use.

3. BUILDING STRUCTURE SURVEY

The parts of a building from which heat is lost by transmission through the materials and by the infiltration of cold air and the exfiltration of an equal volume of warmed air are the walls and the roof, and, to a very minor extent, the foundation below ground level. Each of these parts contains many smaller features that must be examined and studied to save heat. Among such features are the windows and transoms, the exterior doors, loading platforms, penthouses and skylights. Interior features, such as partitions, elevator shafts, stair wells and floor openings, also play a part in the saving or loss of heat and corresponding saving or waste of fuel.

The relation of these features to heat loss are given in order below.

Walls

The kind of materials, and their thickness and arrangement in walls to provide dead air spaces, are fundamental considerations in the prevention of heat loss.

A plain 8-inch solid brick wall will permit the loss of 0.50 Btu of heat per square foot of exposed surface per hour per degree difference in temperature between the air on its inside and that on its outside with a wind velocity of 15 miles per hour. Increasing the thickness of the wall to 12 in. decreases the loss to 0.36 Btu (or by 28%) and increasing it further to 16 in. decreases the loss to 0.28 Btu, or by 44%.

Doubling the wall thickness of the 8-in. solid brick wall decreases the loss from 0.50 Btu to 0.28 Btu, while installing some plaster and insulation on the 8-in. wall reduces heat loss to 0.12 Btu. *The important point is that if a wall is in place, the heat loss can still be greatly decreased by the application of insulation.*

There are many kinds of walls. To some, insulation can be applied more easily than to others. There are also many kinds of insulating materials. The expense of the materials varies, the expense of application varies and the results to be obtained, as can be judged from the figures given above, also vary. Perhaps the insulation which will prevent the greatest loss is not best for a certain wall because some other kind which will give almost as good results will cost much less. An unbiased engineer who is familiar with such problems alone can determine what is best in many cases.

In investigating insulation this thought should be borne in mind, that the losses given here are per degree Fahrenheit difference in temperature between the inside and the outside air. In the warmer parts of the country the average outside temperature is higher than in the colder areas. The investment in the South will not be greatly different from that in the North, but the fuel to be saved per square foot insulated will be more in the North because of the lower average outdoor temperature. The installation of insulation anywhere will make the inside surface of the walls thus covered or filled more nearly the temperature of the air in the enclosed space. Thus radiation of heat from the human body in winter and to the body in summer is decreased and greater comfort is attained.

In addition to transmission losses, there are also losses by the passage of air through the walls. If there are cracks or unused openings through a wall, cold air will move in, replacing warmed air which will escape elsewhere. The entry of such air, over and above the varying amount required for ventilation, is a loss, as the cold air thus admitted must be heated. All such openings should be closed tightly, including those often overlooked in basements.

It should also be possible to shut off useful wall openings when not in use. Among such openings are those for ventilating fans. Over such openings should be placed hinged louvers in such a way that they will open only when the fan is in operation.

Where openings exist through the outer or the inner surface of two part walls, such as found in frame buildings and stucco buildings, they should be eliminated, even though they do not go through both surfaces. The space between these surfaces is partially occupied by studs and partially filled by air if not filled with insulation, and is known as dead air space. The dead air being heated by the inner surface and cooled by the outer surface is in limited motion down on the outer surface and up to the inner surface to an extent depending on structural features, such as fire stops. Temperature of the dead air is obviously higher than that of the outside air and lower than that of the room air. If openings permit the entrance of cold air and the loss of partially warmed air in the dead air space, the average temperature in the space is lowered, which results in a greater loss through the inner surface and a lesser loss through the outer surface. The greatest loss will occur if there are openings from the so-called dead air spaces (1) into the basement permitting the cold air to flow into this area, cooling it and the floor above and (2) into the roof space raising its temperature and the loss therefrom. Repairs to prevent the entrance and exit of air from dead air space should be undertaken.

Buildings with floor heights higher than needed have more exposed wall surface and greater transmission losses.

FORM B. 35 BUILDING IMPROVEMENTS TO SAVE HEAT

WALLS
1 Add insulation
2 Close openings or cracks
3 Install movable louvers on fan outlets and other useful openings
4 Shut off "dead air" space openings to basement and roof space

WINDOWS AND TRANSOMS
5 Replace those unneeded with wall
6 Replace missing, broken or cracked lights of glass
7 Install storm sash
8 Caulk frames
9 Set sash strips to prevent rattle
10 Weatherstrip
11 Caulk sash when not opened
12 Install locks if missing
13 Install new cords if broken
14 Replace window weights if not of proper size
15 Install shades
16 Remove window ventilating fan

EXTERIOR DOORS
17 Replace any unneeded with wall
18 Weatherstrip
19 Caulk frame
20 Reinstall lock-keeper to stop rattle
21 Install storm doors — with vestibule, if possible
22 Install revolving doors
23 Install door checks

LOADING PLATFORMS
24 Install partition with double swinging door to main part of building
25 Install exterior door if space permits

ROOFS
26 Add insulation
27 Close openings or cracks
28 Install louvers

PENTHOUSES
Improvements indicated above under walls, windows, doors and roofs

SKYLIGHTS
29 Replace those unneeded with roof
30 Install second frame below the first

INTERIOR
31 Close off elevator shafts and stair wells
32 Install partitions
33 Install doors in existing partitions
34 Close up floor openings
35 Close open fireplaces

FORM C. BUILDING STRUCTURE
CHECK LIST (EXTERIOR)

Building Name..... Checked by.....
Location..... Date.....

EXTERIOR WALLS	East Side	West Side	North Side	South Side
Need insulation				
Have open cracks				
Unneeded openings should be closed				
Fan opening needs louvers				
EXTERIOR DOORWAYS				
Unneeded				
Frames need caulking				
Doors rattle				
Need weatherstripping				
Weatherstripping needs repairs				
Door check needed				
Door check needs repairs				
Storm door needed				
Storm door needs repairs				
Revolving door could be used				
Revolving door needs repairs				
LOADING PLATFORM				
Needs outer door				
Door needs repairs				
Needs rear partition				
Swinging partition door needed				

ROOF	
Needs insulation	
Needs ceiling	
Has open cracks	
Unneeded openings	
Fan opening needs louvers	
SKYLIGHT	
Glass needed	
PENTHOUSE	
Needs insulation	
Has open cracks	
Unneeded openings	
Frames need caulking	
Doors rattle	
Door checks needed	
Door checks need repairs	
Windows rattle	
Needs Weatherstripping	
Weatherstripping needs repair	
Door locks needed	
Door locks need repairs	
Window locks needed	
Window locks need repairs	
Needs glass	
Needs putty	

Windows and Transoms

Windows account for a very considerable percentage of heat loss from buildings. The losses are of two kinds as mentioned—transmission and infiltration. Above it was shown that a 16 in. thick uninsulated wall has a transmission loss of 0.28 Btu per square foot per degree per hour. The loss from a square foot of window is 1.13 Btu on the same basis, or more than four times that of the wall. Windows have their proper place and size, but from the viewpoint of heating a building, all unneeded windows, such as those in elevator shafts, should be removed and the space in the wall filled in with brick, stone, glass block, tile or other suitable material. Something combining the use of insulation would be effective as a filler, such as a layer of brick with rock wool and plaster on the inside. Use of glass block would cut the loss from 1.13 Btu to between 0.46 and 0.49 Btu, depending on the kind used, and still permit the entrance of light. If this material is installed, the means of cleaning the outer surface should be considered.

One of the worst conditions possible from a heat loss viewpoint is a broken or missing window light. These and cracked lights should be replaced without delay.

Installation of a second glass pane or storm sash decreases the loss to 0.45 Btu, or by 60%, and it also greatly increases the comfort of those sitting near windows by decreasing the removal of heat from their bodies by radiation and by convection air currents.

Justified complaints on a cold day may be received from a person sitting near a window in a room satisfactorily heated because a current of air, cooled by the glass over which it passes, descends on the person, and because heat is given up by the person to the window by radiation. With a storm window in place, the inner glass surface is warmer, the down draft is decreased and less heat is lost by radiation, so the person feels more comfortable.

The total saving to be made by installing double panes or storm sash depends on how low the average temperature is at the location where the sash is installed.

Solid shutters, which often may be closed at night and continuously in unoccupied rooms, act on the same principle as storm sash to decrease transmission losses during such periods as they are closed.

Show window areas usually have at the back a partition separating them from the store. This is a valuable adjunct in properly heating the front of the store. The partition should be tight, as its action is similar to that of a storm sash.

There is also a loss due to the entrance of cold air around some windows on the windward side of buildings and on the lower floors of high buildings and a corresponding loss of warmed air at leeward side windows and in the upper floors of high buildings.

How much air passes depends on the amount of space there is available for it to move through. These spaces are (1) between the wall and the window frame, (2) between the window frame and the sash, (3) between the sash and the lights of glass, and (4) through defective lights.

The space between the frame and masonry walls can be decreased by caulking or filling the space with suitable compound which is forced in the cracks with a gun and hardens. The presence of cracks between the wall and the frame and between the frame and the sash in sooty atmospheres is sometimes revealed by soot marks on walls and sash.

Tests on any two windows would probably show different quantities of air leakage. In one test the air flow with a 15 mph wind was reduced from 14.0 cu ft per foot of crack per hour to 2.6 cu ft per foot by caulking.

The available space for air passage between window sash and windows is usually decreased by the installation of metal or felt weatherstripping. Another important step is to eliminate sash rattle by setting up the stop strips on the sides of the frame, thereby decreasing the space for air passage. The fact that there is rattle indicates a poor fit. A test has shown that the air passage through a very poorly fitting frame window can be decreased more than 70% by weatherstripping. Passage of air about a metal double-hung window has been decreased by more than half by weatherstrips.

In certain instances where it is unnecessary to open double hung windows for cleaning or other purposes, it is possible to apply caulking compound between the sash and the window frames at less expense and more effectively than weatherstripping. The greatest saving is possible where an unneeded window is replaced by wall. The greatest loss occurs when a window is without glass.

Window weights are important. If those in the lower sash of double hung windows are too heavy they will tend to raise the sash. If those in the upper sash are too light, they will tend to allow the sash to drop. This makes larger cracks for air to flow through.

Pulleys and window cords should be in condition, as there may be a tendency to leave poorly operating windows open.

Locks should work perfectly to keep the sash of windows tight to frames. A tenant of the author recently complained that soot was entering around weatherstripped windows. Examination showed this to be coming in at the window corners where the strips did not close the space entirely. Another location was around the pulleys of double hung windows in clapboard walls. When windows are not being

used, this can be prevented by the use of wads of cotton in each of the openings.

Window Ventilators

Window ventilators, both natural and motor operated, are a potential source of heat loss. The possibilities are illustrated by the office 10 x 18 x 10 ft with a double-hung window 4 x 7 ft. The volume of air in this room is 1820 cu ft. If two or three persons are in this room, each would require 7 cfm of outside air for ventilation, with or without recirculation; if four, about 8 cfm.

It has been shown that even with weatherstrips on the window at that location, 910 cfm of outside air is admitted per hour, enough for two persons, who would need only $(2 \times 7 \times 60) = 840$ cubic feet.

When three are present in this small office, the hall door if opened might supply the additional air needed. If more were crowded into the space, undoubtedly the window should be opened sufficiently, at times only of such occupancy, to provide enough ventilating air.

This is preferable to the installation of a natural draft window ventilator with or without movable dampers, because if the latter is used, it is more likely to be left open and permit the entrance of air when it is not needed.

Assume a motor operated window ventilator is put in operation, delivering 450 cfm or 27000 cu ft per hour to the room. This is 15 air changes per hour, or 21 times as much ventilating air as is needed by three persons. It will not be turned on long during occupancy on a cold day because the radiation will not heat this much air. The excess cold air will force its way through all available cracks around the door into the hall and around the window back to the outside. The hall will be chilled. If such a fan is left in operation when the room is vacated, damage may occur from freezing pipes, not to mention the great heat loss. If a motor-operated fan is installed, care should be taken to see that its capacity is no more than the maximum required for the worst condition under which it will operate.

Exterior Doors

There are many types and arrangements of doors. The heat losses through and about common swinging doors are similar to those losses described above, under Windows — through transmission and by infiltration — except that doors are opened and closed more often and during these periods there is a great loss, as the cold air rushes in, or the heated air out.

When an unneeded door can be replaced by wall, there is a permanent saving.

Door checks when operating properly assure the quick closing of doors and a minimum infiltration loss when the doors are in use.

Weatherstripping around doors will greatly decrease the infiltration losses. The door lock should operate so that the door will go tight against the weatherstripping when the door is closed.

Storm doors provide similar savings in doorways to those provided at windows by storm sash. Tightly fitting storm doors are the best, as they prevent cold air entrance to the space between the doors.

Storm doors should be built far enough outside the main door, when possible, so that there is a vestibule and the main door has closed behind a person leaving the building before the storm door opens, and vice versa.

Revolving doors, well weatherstripped, eliminate infiltration losses to a great extent when the door is in use, for instead of allowing cold air to blow directly into the adjacent room as it does when an ordinary single door is opened, only the few cubic feet of air in one door quandrant enters and a similar amount escapes through a second.

Loading Platforms

Loading platforms may be a source of great heat loss if not properly arranged. The condition is most ideal where an outer door can be quickly opened allowing a truck to back up to a platform so designed that the truck is entirely in the loading room. The outer door is closed at once. A suction system in some cases is installed under and at the front of the platform floor to remove fumes from the truck exhaust before it spreads through the loading room atmosphere. A rear partition between the loading room and the building proper with double swinging doors makes the loading room into a large vestibule, with the advantages cited above.

A less ideal arrangement is one with a rear partition and swinging doors, but not enough depth to permit the closing of the front door when a truck is at the platform.

The worst arrangement is where there is no back partition or swinging doors and when a truck is at the platform, cold air sweeps into the building.

Roofs

The same principles that apply to walls also apply to roofs.

A popular way of decreasing heat loss in buildings with roof space is to pour loose rock wool insulation on the top floor ceiling plaster to a depth of 2 or 3 inches. This is an inexpensive way of making a considerable saving where conditions are proper.

What has been said of wall openings might be repeated with emphasis in regard to roof openings, because of

FORM D. BUILDING STRUCTURE CHECK LIST (INTERIOR)

Building Name..... Checked by.....
Location..... Date.....

	No. 1	No. 2	No. 3
WINDOWS			
Window is unneeded			
Frame needs caulking			
Sash is loose			
Needs weatherstripping			
Weatherstripping needs repair			
Lock needed			
Lock needs repair			
Glass needed			
Storm sash needed			
Storm sash needs repairs			
Sash cord or pulleys needed			
Weights should be changed			
Shade missing			
Ventilating fan in place			
EXPOSED WALLS			
Cracks			
CEILING			
Cracks			
Needs insulation (top floor)			
PARTITIONS			
Needs door			
Door needs lock			
Lock needs repairs			
Transom unneeded			
Transom needs glass			
Transom lock needs repairs			
FLOORS			
Unneeded openings			
Needed openings need covers			
ELEVATOR SHAFTS			
Need solid walls and doors			
Walls and doors need repairs			
STAIR WELLS			
Need solid walls and doors			
Walls and doors need repairs			
BASEMENT			
(Check in above)			

FORM E. 29 SYSTEM IMPROVEMENTS TO SAVE HEAT

1 Insulate bare steam lines
2 Insulate bare flanges, valves, expansion joints and fittings
3 Insulate return lines
4 Disconnect unused lines from the system
5 Disconnect unneeded radiation
6 Disconnect used but unneeded lines
7 Replace bare lines needed for heating, by radiation
8 Install special lines to areas requiring heat when the building elsewhere does not
9 Equip valves so they are accessible
10 Replace radiators that are either over-sized or undersized
11 Install orifices in radiators and lines
12 Replace lines and equipment that are too small
13 Relocate improperly placed radiators
14 Remove handicapping shields, covers or water pans.
15 Repaint with oil paint, radiators painted with metallic paints
16 Remove obstructing furniture
17 Eliminate radiator connections with water pockets
18 Replace or repair faulty air valves or traps
19 Remedy trapped, clogged, broken or leaking lines
20 Repair broken, leaking or clogged shut-off valves
21 Have a control man service the control system
22 Overhaul pumps and other equipment
23 If there is no automatic control, institute a schedule of shut-off valve operation
24 Repair boiler leaks
25 Replace missing boiler insulation
26 Repair stoker
27 Repair burner
28 Repair air handling equipment
29 Repair water treatment equipment

the effort of warm air to rise and escape at the top.

Potential points of heat loss that may be eliminated are unused chimney flues, unused vent stacks, used vent stacks without louvers, and loose fitting hatch covers.

Penthouses

Penthouses above stair wells and elevator shafts are potential sources of great heat loss. The door to the roof is often found open. Sometimes the windows are allowed to remain open or the glass to be missing for months. Weatherstripping and door checks are often forgotten at this little seen, but important, point. The walls and roof are often of inferior quality. If conditions below are such that heated air can rise from the building through the shaft to the penthouse, openings function similar to outlets of chimneys, and all should be improved or eliminated. Openings between penthouses and the building proper should also be closed as nearly as possible.

Skylights

Occasionally there will be found a little needed skylight which can be replaced by roofing. Sometimes when it must be left in place a second frame of glass can be placed underneath the first, the saving effect being the same as that accomplished by installing a storm sash. Cleaning may be a problem.

Interior Features

Practically all changes for heating purposes that are made in the interiors of buildings — that is to building parts that are not exposed to outside temperature—are done to retard the movement of heated air within the structure. As stated above, cold air tends to filter in at the windward side of a building while heated air in equal volume moves out at openings on the leeward side. Also heated air being lighter in weight than cold air rises wherever possible. The following steps can be taken to retard these actions.

Partitions

Not all locations should be maintained at the same temperature. Vacant rooms need not be heated to as high degree as are occupied ones. Partitions with doors are a necessary adjunct to maintaining a lower temperature in certain areas. Hallways may be kept at a slightly lower temperature than office space, but to do this doors and transoms in partitions between these spaces must fit tight and be kept closed.

The author is familiar with a court house in which a considerable saving was made by this means. This structure had a large open court. The public hallways lined this court. Beyond on the outside were the court rooms and private hallways. Visitors standing about in the public halls were heavily dressed as a rule. They frequently opened the windows into the court yard, cooling the public halls. The doors to the court rooms were kept closed. The heat furnished the public halls was decreased, with a resulting saving.

Elevator Shafts and Stair Wells

Easiest means for hot air to escape is up the elevator shaft when this area is separated from the hallway on each floor by open iron grille work or something of this nature, as was frequently done in the past. Hot air rising overheats the upper floors and cools the lower ones, and more heat is needed below. The damage is multiplied when someone, becoming overheated, opens a window on an upper floor, allowing the hot air to escape.

The remedy is to erect solid partitions and doors which are open only when in use.

The same comments apply to stair wells.

Other Openings

Other minor openings may occasionally be found which permit the flight of heated air upward and out. For instance, an opening from floor to floor containing a spiral gravity conveyor to move boxes from upper floors down to the shipping platform, while a great convenience, will be bad from a heat loss view unless provided with a wall and doors on each floor.

Another source of loss is open fireplace flues without dampers.

Form B (page 39) is a list of building improvements that may be made to save heat. As stated, not all apply to every building. If made in some structures certain changes would cost more than would be justified by the value of heat to be saved. This must be determined in each case. The fuel shortage and comfort of tenants should at the present time also be considered.

Form C (page 40) is a check list for use in checking exterior defects in building structures and Form D (page 41) is a check list for interiors.

4. SYSTEM AND CONTROL STUDY

How to decrease the loss of heat from the building has already been described and the reasons have been given why over-heating increases the loss. Since under-heating causes discomfort, the next points covered have to do with how to maintain just the right temperatures.

Bare Lines

Whenever steam can not be shut off in a room or area when the desired temperature is reached, the room overheats and there is an increased transmission loss. Such a condition exists when bare steam lines pass thru a space, give off unwanted heat and must be kept filled with steam to supply needed heat elsewhere.

The temperature of saturated steam in the steam lines of heating systems is usually at or a few degrees above 212F, except in sub-atmospheric systems, where it is less. How much it is above 212F depends on the pressure carried on the system at the time. At 5 lb gauge pressure, for example, the temperature of saturated steam is 227F, and each pound will lose 960.6 Btu in returning to water.

For the purpose of considering how much heat is lost from bare steam lines, it may be assumed that the air surrounding such a steam line is at a temperature of 70F. The difference between the temperature of the steam inside the line and the air on its outside is (227 — 70) 157F. Tests have shown that with this temperature difference the line transmits to the surrounding air and structure about 2.5 Btu per hour per sq ft of exposed surface per degree difference. For large lines the loss is slightly less, being 2.25 Btu for those of a 12 in. size and for small lines it is slightly more, being 2.78 Btu for ½ in. lines.

If the bare line is so located in the system that steam fills it during the whole heating season, the loss is very considerable from each square foot. Assuming that the season is 8 months, 240 days or 5760 hours long, then

$$\frac{5760 \times 2.5 \times 157°}{960.6} = 2350 \text{ lb of steam}$$

is condensed per sq ft of pipe

If steam costs $0.50 per thousand pounds, the loss per season is

$2.350 \times \$0.50 = \$1.18$ per sq ft of bare pipe.

However, several factors should not be lost sight of in this deduction. If the line is filled with steam only part time, the loss will be proportionately less. Also, steam may cost more or less than $0.50. Not all the heat transmitted is lost, as it may at times warm the air and surrounding objects when heat is needed. Nevertheless, generally, bare lines should be covered.

Value of Insulation

Insulation 1, 1½, or 2 in. thick is usually applied to steam lines to decrease the heat transmitted from them. The thickness is selected, if done by an engineer in a scientific way, by comparing the cost, in place, of the insulation of each thickness with the annual savings it will produce by a decrease in fuel use. The table shown below shows that the application of insulation 1 in. thick stops 83% of the transmitted heat; the application of ½ in. additional insulation brings the savings up only 4% (to 87%) and the application of still another additional ½ in. increases the savings only 2% more (to 89%). As the cost of the extra material is considerable, the value of the fuel must be enough to warrant adding the additional thickness of insulation.

Many times insulation is placed on steam lines but left off the flanges, valve bodies and other fittings, even though they represent considerable surface. For example, a pair of 3 in. flanges is equivalent to 0.945 sq ft of bare line; a 90 degree ell to 2.38 sq ft; a tee to 3.66 sq ft and a cross to 4.77 sq ft. Where flanges and fittings are eliminated by the use of welding, the job of insulating it is simplified. It is true that it is a little more difficult to cover valves, expansion joints and other fittings, and later the covering must be removed first before any work can be done on them, but when the object is to save fuel, these and all surfaces with steam on one side and air on the other should be insulated.

The return lines carrying hot condensate should be insulated too if boilers within the building furnish the heat, for the higher the temperature at which the condensate returns to the boiler, the less fuel will have to be burned to change it back to steam. Also, if district steam service is taken and heat in the condensate is used to pre-heat water or for other useful purposes, they should be covered.

Lines installed larger than necessary have more surface than needed and give off more heat than they would if properly sized.

Unused Lines

From these observations in regard to the losses from bare and insulated lines, it is evident that any steam line that is no longer needed as a part of the heating system, especially if bare, but even though insulated, should be disconnected so that there will be no possibility of steam being wasted in it. It is better to remove the line than to depend on a valve and to keep steam out of it, for the valve may be opened in some unknown way or may develop a leak.

Sometimes radiators will be found in seldom used stair wells and at other locations where heat is not needed. These should be removed.

Used but Unneeded Lines

Occasionally there will be found two steam lines near to each other. If the total radiation connected to both is not too much for the larger line to serve, according to present standards, they should be cross connected at points as far out on the lines as feasible and the smaller line cut out of service back to its connection with the main.

Bare Line Heating Unsatisfactory

In mild weather basement space heated by bare lines will be uncomfortably hot. It can be heated more satisfactorily, if necessary, by some form of radiation with valves to shut it off when not needed. In the first place, there is little heat required in basements of the usual type, mostly below ground, because there is little heat lost by transmission through the foundation walls and basement floor to the surrounding earth which is not at a low temperature. There is no loss through the ceiling above, as the first floor is ordinarily heated at least as high, so the principal loss is through that part of the walls above ground. For extremely cold days a small amount of radiation properly installed in the engineer's or custodian's office will be sufficient.

An old building engineer once protested the writer's recommendation that he insulate the bare lines in the basement, which were large and many in number, saying that if these lines were covered he would be too cold. At possibly $1.00 per square foot of line surface per year this was expensive heating and the large use per 1000 cubic foot of heated space per degree-day in the building was evidence of waste.

What has been said of basement lines also applies to piping above this level in the building. Bare lines that heat space satisfactorily on a cold day will overheat it on a mild day. Bare lines in roof space are especially wasteful.

Long Hour Heating

When there are areas in a building such as restaurants, stores or doctor's offices, with night or long-hour uses —in other words, occupancy at hours when the rest of the building is untenanted—separate service lines for these areas should be run back to a point on the main supply line or boiler header ahead of the main shut-off valve, so that the system may be shut down and still permit the service of steam to the long-hour users. In some cases where long-hour occupancy is rare, a check up may show it economical to supply heat temporarily by means of electric heaters rather than to turn on heat in all lines in the building to supply a small area. Boilers operating at such times at a small percentage of their capacity operate inefficiently. Generating losses are entirely eliminated where steam is purchased.

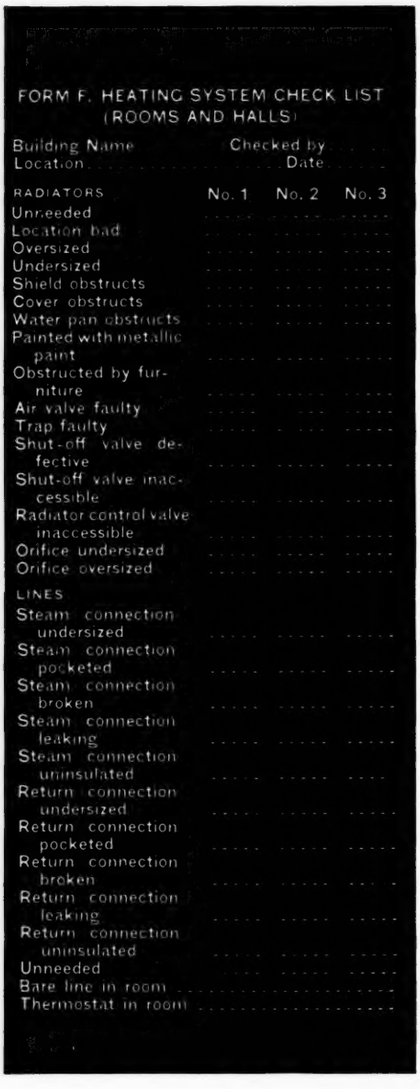
Accessibility of Valves

All the data given previously attest to the desirability of being able to shut steam off any line when heat from it is not needed. Valves to do this may have to be installed. When they are in place but are in such a position that they can not be reached easily by the person charged with the responsibility of operating the heating system, they may not be closed at times when no steam should flow through the line. Valves often of necessity are erected at points near ceilings far out of reach of the building engineer, who must climb a ladder to reach the wheel. Such valves will be used very little.

There are several ways of remedying such inaccessibility. The simplest

SAVING IN HEAT BY INSULATING 1 LINEAL FT. OF 3-IN. PIPE
(Based on 157F temperature difference, medium to room air, and 85% magnesia insulation)

Insulation	Heat Emitted per Lineal Foot, Btu per Hr	Saving, Compared with Bare Pipe, %
Bare pipe	355	—
With 1 in. Insulation	60	83
With 1½ in. Insulation	45	87
With 2 in. Insulation	38	89



FORM F. HEATING SYSTEM CHECK LIST
(ROOMS AND HALLS)

Building Name ..... Checked by .....
Location ..... Date .....

RADIATORS	No. 1	No. 2	No. 3
Unneeded			
Location bad			
Oversized			
Undersized			
Shield obstructs			
Cover obstructs			
Water pan obstructs			
Painted with metallic paint			
Obstructed by furniture			
Air valve faulty			
Trap faulty			
Shut-off valve defective			
Shut-off valve inaccessible			
Radiator control valve inaccessible			
Orifice undersized			
Orifice oversized			
LINES			
Steam connection undersized			
Steam connection pocketed			
Steam connection broken			
Steam connection leaking			
Steam connection uninsulated			
Return connection undersized			
Return connection pocketed			
Return connection broken			
Return connection leaking			
Return connection uninsulated			
Unneeded			
Bare line in room			
Thermostat in room			

of these is to secure a long rod with a hook on one end. The engineer holds the straight end, puts the hook over a spoke of the valve wheel and pulls down, moving the valve wheel open or shut about 45°. Sufficient of these pulls either opens or shuts the valve.

A second scheme involves the purchase of a chain and sprocket wheel to replace the hand wheel on the valve. The engineer is enabled to open or close the valve from the floor below.

A third plan has only a limited but occasionally very useful application. The valve is turned so that the stem is vertically upward. In this position, with an extension stem if necessary, to bring it above the first floor, the wheel is easily operated on this level. In store buildings where the store personnel control their own heat, this is a convenient arrangement, making it unnecessary for them to go to the basement. The arrangement is only feasible when the valve stem comes through the floor at a satisfactory location, such as under a counter.

Occasionally there is a condition where the personnel of a store in a building buy their steam service, or at least desire to control their temperature, and do not have access to the shut-off valve in the basement and, therefore, must shut off the heat at the radiators. This leaves steam in the lines and a continuous waste results. A motor-operated valve installed at the start of the line with push button control in the store will stop the loss and be a convenience. This can be combined with a room thermostat and time clock without greatly increased cost to give additional satisfaction.

Standard for Radiation Selection

Proper indoor temperatures during occupancy hours may sometimes be as high as 80 or 85F, or as low as 40F for special uses, but for simplicity, the assumption is made that 70F is satisfactory in the discussions following. For the same reason, the outdoor design temperature is assumed to be 0F, although in Los Angeles it is 30F and in very cold locations in North Dakota and Montana it is —30F.

In the case assumed, the radiator (or radiators) in each room should be of such a size as when filled continuously with steam at about 215F, to keep the room after improvements have been made, at 70F—the selected indoor temperature, when it is zero outdoors—the selected outside design temperature, and there is a 15 mile per hour wind.

The heat loss survey and simultaneous radiation check showed (1) how much radiation was needed before and after improvements were made, and (2) how much is in place in the building.

Proper Sizing of Equipment

The next step in system improvement is to balance the radiation. This involves replacing any undersized radiators with larger ones and oversized radiators with smaller ones. Some of those needed may be secured by exchange between rooms.

Sometimes a building may be found with inadequate radiation on one side. This may be the result of the razing of an adjacent building on that side. Larger radiators and piping may have to be installed for comfort and balance. If an adjacent building is vacant and unheated there may be some difficulty in heating rooms on the side next to this building.

Steam, when turned in to a system, reaches the nearest radiator first and begins filling it. The radiator farthest away does not begin to fill until some time later. The result is that if both rooms have the proper radiation, the near room overheats while steam is being left on to heat the far one. This difficulty is overcome by installing properly sized orifices in the inlets of all radiators. This adds enough resistance to the system so that the start and finish of filling radiators takes place in unison as is necessary.

When the size of orificed radiator to be used at any location has been settled, the steam connection, radiator valve, air valve, radiator trap and return connection for that radiator can be checked for size from catalogs or with the manufacturer.

When the capacity (square feet) of the radiators connected to various lines and risers is known, the proper sizes of lines, drip-traps, airvents, pumps, etc., in the system back to the boiler or service inlet can be determined. These items should be neither too small nor too large, but especially not too small.

Orifices are also placed in lines to aid in the problem of delivering steam to all radiators simultaneously.

Servicing Equipment

After what has to be done to correct equipment sizes is known, the next step is to inspect the equipment to be sure it will function as intended. For instance, even though a radiator is properly sized, it will not emit the expected amount of heat

(a) If it is not located along a cold outside wall, preferably under a window where the coldest air will come in contact with it;

(b) If it is surrounded with a shield or covered with a cloth, metal cover or water pan so close to it as to obstruct the necessary flow upward of air over its surfaces. When such equipment is desired for appearances, larger radiators are needed to prevent underheating;

(c) If painted with metallic paint which decreases the heat radiated from it, lowering its output by about 10%;

(d) If an obstruction, such as a piece of furniture, is placed in front of it;

(e) If the steam connection has a slope down with the flow creating a pocket which fills with condensate and prevents the easy entrance of steam;

(f) If the return connection has a low spot preventing the exit of air from the radiator and in turn the entrance of steam to it. The radiator is then air bound. When a radiator has long steam or return connections, in time these may be bent down by persons tramping on them, and for proper circulation they must be straightened to remove the pocket.

(g) If an automatic air valve on a one-pipe system does not open to permit the removal of air from it, and

(h) If the radiator trap on a two-pipe system fails to open to remove condensate and air.

Similarly the basement steam lines and the risers will not supply the needed steam to the radiator connections

(a) If the lines are trapped, clogged, broken, leaking or frozen;

(b) If a shut-off valve is clogged or broken;

(c) If the temperature control system is not in proper operating condition;

(d) If air vents are not removing air fast enough;

(e) If drip lines and traps are not removing condensate fast enough, and

(f) If any other equipment, such as pressure reducing valves, are not functioning.

Equipment which has moving parts is most likely to get out of repair and not function properly. Among such items are those that follow.

Shut-off Valves

With the exception of a few modulating radiator valves, which are intended for partial opening, shut-off valves on steam heating systems are designed to be left either completely open or entirely shut. Operators sometimes leave valves slightly open intending to secure only a limited flow of steam in the system. They usually do not succeed entirely in their efforts, but in time the valve may be worn or wire-drawn, by the steam spurting through the space between the gate and seat of the cracked valve, unless it is made of a very hard alloy. Any valves that do not stop flow completely should be promptly repaired.

Radiator Traps

A radiator trap, functioning properly, permits condensate to flow into the return line along with air, while holding steam in the radiator until it has lost its heat to the metal and condensed. It should pocket any grit, rust or scale that reaches it and continue to work when these or oil are present.

These traps are usually of the thermostatic type which depend on the expansion and contraction of either a volatile liquid within a metal container, called an element, or the expansion and contraction of metals, to close and open a valve.

When trouble occurs, it is usually due to failure of the element or to the valve pin not seating tightly.

Whenever a trap does not properly open to discharge condensate and air, these begin to fill the radiator, preventing the entry of the normal steam supply and heat emission is decreased from the radiator. Water hammer may occur. The heated space is cooler as a result of the failure of the radiator to heat. If there is a complaint and the custodian, instead of realizing that the trouble is in the trap and repairing it, keeps steam on in the building longer than is necessary with the prevailing weather, there is overheating and fuel loss.

Traps may stick open, as well as closed. On such occasions steam passes into the return line with the condensate and air. The condensate is heated to a higher temperature than usual. This is not serious if the heat is being used in it, for example, to pre-heat water in an economizer if steam is purchased or by its return to the boiler in private plant operation. However, more heat is given off from the return lines and lost.

In buildings that have thermostatic radiator traps—and they are a part of most heating systems—there should be in the basement a rack for testing them. This consists of a pipe with five or more connections—one to the steam supply, one to the hot water supply, one (or more) for attaching a trap (or traps) to be tested, one to vent the steam and one to drain off the water. This trap tester is used to furnish alternately steam and hot water to the trap so that it may be observed whether the valve drains the water without steam leakage and holds steam.

To avoid trap failures in the heating season, it is recommended that each summer a considerable number of the traps be removed, cleaned, repaired, tested and replaced, and a record kept.

FORM G. HEATING SYSTEM CHECK LIST
(BASEMENT)

Building Name ..... Checked by .....
Location ..... Date .....

STEAM LINES
Unneeded but connected .....
Uninsulated .....
Flanges uninsulated .....
Fittings uninsulated .....
Too small .....
Improperly sloped .....
Pocketed .....
Clogged .....
Broken .....
Leaking .....
Special service needed .....
Shut-off valves not accessible .....
Shut-off valve broken .....
Shut-off valve clogged .....
Shut-off valve leaking .....

RETURN LINES
Uninsulated .....
Too small .....
Improperly sloped .....
Clogged .....
Broken .....
Leaking .....

TRAPS
Too small .....
Faulty .....
Cooling leg too short .....

AIR VENTS
Too small .....
Faulty .....

RADIATION
Needed .....

CONTROL EQUIPMENT
Motor faulty .....
Wiring faulty .....
Tubing faulty .....
Clock faulty .....
Mechanism faulty .....

PUMPING EQUIPMENT
Motor faulty .....
Wiring faulty .....
Pump faulty .....

PRESSURE REGULATOR
Diaphragm faulty .....
No pressure gauge .....
Improperly installed .....
Governor line faulty .....

GENERATING EQUIPMENT
Boiler leaking .....
Boiler needs insulation .....
Stoker needs repairs .....
Burner needs repairs .....
Air handling equipment needs repairs .....
Water treating equipment needs repairs .....

Radiator Air Valves

On gravity air vent-heating systems radiator air valves are installed on the side of each radiator to permit the escape of air from the radiator so steam can enter. There are two types. The one permits air to come back into the radiator when the valve is turned off and the steam left in the radiator condenses and decreases in volume. The other—the vacuum type—does not.

The relative heat output of an undersized radiator on a gravity air vent system can be increased somewhat by substituting an automatic vacuum air valve for an ordinary air valve, if non-vacuum valves are in use elsewhere. The improvement is the result of steam, when turned on, entering more quickly into this radiator due to the absence of air and remaining longer when turned off, because no air can rush in to replace it. The opening and closing of air valve ports depends on thermostatic and float action within the valve. Troubles are similar to those with thermostatic traps and heat losses occur for the same reasons.

The remedy is to replace the valve with a good one. Then clean and, if possible, repair and test the defective valve before putting it back in service.

Float and Thermostatic Traps

In some types of heating systems, combination float and thermostatic traps are now used, in place of float, bucket or inverted bucket traps and air vents, to drain condensate and air from the steam lines. They are placed at points where air and condensate collect, such as at the lower outer ends of steam mains. Condensate rising in the trap lifts a float. This opens a valve and the condensate drains out. At the top of the trap body is a thermostatic element which, when steam is present, causes a valve to stay shut, but when air is in the chamber, to open. The trap should not be connected directly to the steam line, but should be on the end of a cooling-leg—a bare length of line—so that the

condensate will be somewhat cooled when it reaches the trap.

If condensate comes back to the basement at a high temperature, this is an indication of bad traps allowing steam to pass.

A program of summer inspection and repair is recommended. Care should be taken to see that the traps are properly located and accessible and that there is one at each place where needed.

Automatic Air Vents

Large separate air vents are placed on steam lines at points where air pockets. Comments given above also apply to this equipment, including that in regard to its proper location.

Steam lines that are air bound or water-logged will not carry steam in the proper quantity to radiators.

Form F (page 44) is a check list covering upstairs heating system items so far mentioned, while Form G (page 45) is devoted to basement equipment, now to be considered.

Line Slope

Steam lines are intended to slope in such a way that the steam which condenses in them flows along their bottoms to traps where the condensate is removed. In time unless adequately supported, the high end may get pulled down enough to change the direction of slope or a sagging may take place, so that a low spot is created. In either case, a pocket of water forms through which steam must push to reach radiators. Longer time to heat up is needed and parts of the system thus retarded will not operate in unison with the rest. Overheating in other parts of the building may occur. Such pockets should be eliminated or additional traps installed to remove the condensate at the low points.

Other Equipment

Other equipment, such as pumps, which is included in the system, should be overhauled and put in the best condition.

Where district steam service is purchased, the pressure regulator should be examined to see that its diaphragm is in good condition. The pilot line should be installed according to the best arrangement and there should be a pressure gauge to show the pressure on the system.

Temperature Control

When the heating equipment is properly sized to maintain 70F inside with zero outside, accompanied by a 15-mile per hour wind, if the outdoor temperature rises 10F and steam is not decreased, the building will overheat and the higher the outdoor temperature, the greater will be the waste of heat. When the outdoor temperature is in the lower thirties, as it is in some locations on average winter days, the system is twice as large as needed and half the heat may be lost unless steps are taken to correct this. This is done by installing a system of either manual or automatic temperature control.

There are three general methods of temperature regulation: Intermittent, modulating, and sub-atmospheric.

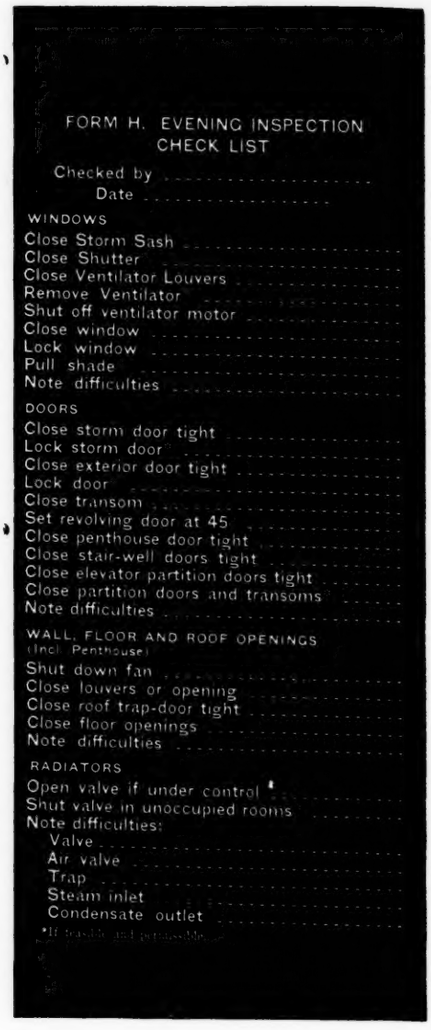
If two buildings without temperature control, one large and one small, are using the same amount of steam per cubic foot per normal year for space heating, the possible savings in the larger building to be had by improving the system and installing control equipment will justify a greater expenditure for the improvements and a more complex control than will the savings in the smaller one.

No control is entirely automatic. All require some service and adjusting.

Granting that there are many exceptions, some of which will be mentioned below, for purposes of considering how temperature can be kept to the desired degree, the day can be divided into four periods: the warming up period in the early morning, the period of occupancy during the day, the cooling off period in the evening, and the late night period of minimum temperature.

Small store buildings probably follow this pattern more closely than others. Small office buildings may have a few tenants occupying their space after the usual hours all the time or during certain periods of the year. This may make the building management extend the daytime temperature of 70F to all or part of the building into the evening hours. In large buildings usually several risers are served steam from a branch main, either in the basement or roof space. This is called a *zone*. It may be possible to shut steam off from some zones while leaving it on in others due to the presence of persons. Hotels and apartments are occupied all the time, yet there are times and parts where lower temperatures may be carried if there are suitable valved lines to do this. Some buildings are partly vacated at noon on Saturday and have few occupants from then until Monday morning.

Cleaners at work in a building at night should be satisfied with 60F. While they dress and undress and have their lunch hour, they will want a temperature of 70F, so it is well to have a central location for them which can be kept to this temperature without overheating the rest of the building. By scheduling the cleaning to begin in the early evening and to be completed during the cooling down period, it might be possible in some buildings in these times to allow the temperature to drop lower than would be possible, with the janitors at work later at night. Where there are several zones, another heat saving arrangement would be to have the cleaners work first in one zone, which would be kept at 60F while they were present, and then allowed to cool further. The other zones would be raised to 60F only when the cleaners were scheduled to be there.



FORM H. EVENING INSPECTION CHECK LIST

Checked by .....
Date .....

WINDOWS
Close Storm Sash .....
Close Shutter .....
Close Ventilator Louvers .....
Remove Ventilator .....
Shut off ventilator motor .....
Close window .....
Lock window .....
Pull shade .....
Note difficulties .....

DOORS
Close storm door tight .....
Lock storm door .....
Close exterior door tight .....
Lock door .....
Close transom .....
Set revolving door at 45 .....
Close penthouse door tight .....
Close stair-well doors tight .....
Close elevator partition doors tight .....
Close partition doors and transoms .....
Note difficulties .....

WALL, FLOOR AND ROOF OPENINGS
(Incl. Penthouse)
Shut down fan .....
Close louvers or opening .....
Close roof trap-door tight .....
Close floor openings .....
Note difficulties .....

RADIATORS
Open valve if under control .....
Shut valve in unoccupied rooms .....
Note difficulties:
Valve .....
Air valve .....
Trap .....
Steam inlet .....
Condensate outlet .....

Intermittent Control

Probably the best known of the methods of preventing overheating is to turn steam on and off according to a schedule during hours of occupancy. At the end of this period the steam is kept off until the building cools down to the minimum desired temperature. When this is reached a schedule is followed again which holds this temperature until it is necessary to turn it on continuously for the heating up period.

For example, suppose an office building is vacated of workers by 6 p.m., the cleaners come in at 10 p.m. and the office workers return at 9 a.m. From 9 a.m. to 6 p.m. steam is turned on and off according to the daytime schedule to maintain 70F. Steam is then turned off entirely and by 11 p.m. the building on a mild night has cooled down to 60F. This being the minimum temperature desired with cleaners at work, steam is turned on and off by schedule until 6 a.m., when it is turned on continuously until the temperature reaches 70F, which it has been figured would be at 9 a.m.

To operate by this method, the

building engineer or custodian must know by experience how long it takes the heating system to raise the building to 70F from 50F, 55F and 60F, when the outside temperature is from 10F to 60F with varying wind velocities. If the outside design temperature is zero, on those rare occasions when this temperature prevails, he will have to maintain the daytime temperature through the night for the system has not capacity to raise the building temperature again under such conditions. At 10F it will take longer than at 20F, at 20F longer than at 30F, and so on. He must be careful to start heating up at just the right time, for if he starts too late there will be underheating complaints and if too early there is waste.

If in a building the system is such that it must be turned on continuously when the outside temperature is zero and is not needed at all when the outside temperature is 65F, for any temperature between these extremes, steam is required to fill the radiators only a proportional amount of the time. For such a building, daytime and nighttime operating schedules would be as indicated in the accompanying table.

The foregoing demonstrates that even in a medium sized building there will have to be a large number of valve operations to save heat. This can be done by a man almost constantly at the valves, but it can be done better by automatic or semi-automatic control and for less money. In many locations there will be no one present at 3 or 4 a.m. to start the morning heat up.

The length of time it will take a building to cool down from 70F to 65F, 60F or 55F depends on how resistant its parts are to the loss of heat. On mild nights it will be long, on cold nights much less. Cooling may continue to the time and degree when it is necessary to turn steam on continuously to warm the building for morning occupancy or until some minimum night temperature is reached, such as 60F.

With intermittent control there may be some difficulty due to the steam staying off for long periods on mild days. Room occupants should not use their radiator valves, but if one turns his valve on just as the off-period begins, he will not get steam for some time.

With steam supplied from a boiler in the building there is also the difficulty of boiler operation—a full load one minute and none the next. When there are two or more zones this can be relieved by spacing on and off periods so they do not coincide. This difficulty does not occur with district heating.

Modulating Control

The same results would have been accomplished if instead of having steam fill each radiator for a certain number of minutes per hour, steam had been delivered continuously to the radiators but at such rates that the radiators would have been entirely filled at zero temperatures outside, entirely empty at 65F outside and partially filled according to the outdoor temperature of all degrees between these extremes. A radiator half filled with steam will give off as much heat as the same radiator if entirely filled only half time.

The modulating type of operation has this disadvantage, that the lines are filled with steam at all times when a constant temperature is being maintained and, therefore, heat is lost from them at all such times. Intermittent operation has the disadvantage that steam is not in the radiators at all times. Tenants feel cold radiators and believe that they have no heat.

Sub-atmospheric Control

The third method of control is based on the fact that the temperature at which saturated steam condenses decreases as its pressure becomes less. Thus steam at 15.7 lb absolute pressure (1 lb gauge pressure) condenses at 215F, steam at 9.3 lb at 190F, steam at 6.0 lb at 170F and steam at 3.7 lb at 150F. The respective heat emissions per square foot of direct radiation under these conditions with 70F air are 240 Btu, 187 Btu, 148 Btu and 111 Btu. In mild weather the radiator output is further decreased by partial filling.

Room Temperature Control

Control valves are sometimes placed on a radiator or radiators in a room and the operation of such valves controlled by a nearby thermostat. This arrangement has the fault that steam is not removed from the supply lines. If the window is opened in cold weather, the thermostat will cause heat to come on and there will be waste.

Steam Generating Equipment

Buildings furnished with district steam service have no generating losses or difficulties. In buildings where steam is produced on the premises, the operating personnel must be continuously on guard against losing heat up the chimney and elsewhere.

For complete combustion of a pound of coal of any grade, there is a theoretical amount of air needed. The quantity varies somewhat with the kind of coal. In practice, since it must be thoroughly mixed with the fuel, considerably more air is needed under a boiler than thoretically and the amount varies with kinds of fuel and types of boiler.

If insufficient air is delivered, the carbon in the coal will not be completely burned. Unburned carbon in the form of smoke will go up the stack. This is a waste of fuel since all that was needed to burn it was additional air. This type of waste is quite well known due to efforts made from time to time at smoke elimination.

What is not so well known is that if too much air is supplied there is also waste. The temperature of the gases which transmit the heat of combustion to the boiler tubes are cooled and instead of delivering their heat to the metal, it goes up the stack.

Along with a proper air supply, a corresponding even delivery of fuel is desirable. This can be accomplished much better by stoker if coal is the fuel than by hand firing. Unburned particles of coal present in the ash indicate improper combustion conditions. Wet coal requires more heat to burn than dry as its moisture must first be removed before it can be burned.

The following points should be noticed in examining the steam generating system.

The boiler itself should be in good condition, without leaks, and should be properly insulated. Means should be at hand to clean boiler tubes and keep the boiler in repair.

The stoker and other coal handling equipment should be in good condition. If possible there should be some means of measuring the coal burned

OPERATING SCHEDULE

70F Daytime Schedule		60F Nighttime Schedule	
With outdoor temperature of, F	Each hour keep the radiators full of steam for, — min.	With outdoor temperature of, F	Each hour keep the radiators full of steam for, — min.
65	0	55	0
60	5	50	4¾
55	10	45	9½
50	14	40	14¼
45	19	35	19
40	23	30	23¾
35	28	25	28½
30	32	20	33¼
25	37	15	38
20	41	10	42¾
15	46	5	47½
10	50	0	51¼
5	55		
0	60		

or if oil or gas is the fuel, the quantity used.

The air handling equipment should be in repair—dampers workable, etc.

Water to be delivered to the boilers should be treated. The water treating equipment should be such that the necessary chemicals can be properly measured and mixed.

Form E (page 42) summarizes the improvements which can be made to the system to conserve heat and fuel.

5. MAKING THE IMPROVEMENTS

Carpenters, painters, pipe fitters and handy men usually are employed around the larger buildings who can save money for the managements by doing the repair work, insulating, plastering, glazing, roofing, carpentering, brick work and small pipe fitting that may be contemplated. In the smaller buildings some of this work may have to be turned over to contractors because of a lack of personnel. Time is a factor for summer is the best time of year to make improvements and the heating system must be complete and ready for service on the first cool day of autumn. Other kinds of work, such as changes to large pipe —for which the building probably will have no tools — repairing of valves, motors, boilers and stokers, weatherstripping, and inclosing elevator shafts can best be done by contractors specializing in these lines.

Definitely in this group is the installation of temperature control. Some one person or organization should be entirely responsible for the saving to be made. For this reason a heating engineer, who is thoroughly familiar with all phases of the problem, might be employed to assemble the past records, make a heat loss survey, examine the building and system, handle the improvements, run the tests, make the adjustments and finally instruct the building personnel in the operation of the temperature control equipment.

When automatic control is to be installed, if possible, the firm that contracts for this work should also handle, or at least supervise the balancing of the radiation, installation of orifices, and repairs to radiator traps, so that there will be no division of responsibility.

The large temperature control manufacturers of the country are quite reliable and their engineering departments are capable of analyzing the needs of buildings to give comfort and save fuel. They will estimate and sometimes guarantee what the consumption will not exceed in a normal year. When steam or gas is purchased, the steam or gas utility will probably be found equipped to give excellent advice on such problems.

Control should not be bought on a basis of price. One contractor may feel that a building justifies the installation of a more complex control and the doing of more auxiliary work than another. In order that the owner may select the equipment which he feels will best suit his purposes, each prospective bidder should be asked to include certain information in his proposal, which should be delivered by a fixed date.

The price stated possibly should include not only complete installation, but satisfactory adjustment, instruction to the operating forces and service for one year.

While payment is sometimes made in full when the work has been satisfactorily completed and accepted by the owner, with a discount for cash, or in 30 days without discount, other arrangements are occasionally entered into providing for monthly installments or payments out of savings either estimated or guaranteed.

Comfort is a very important item. The proposal should state the maximum temperature deviation that might be expected to be shown during hours of occupancy on thermometers placed in the standard way about the building.

The proposal should state how much time will be required to complete the installation after the order is furnished, to do the work. In this connection, a clear understanding should be incorporated to the effect that work shall be done in tenanted areas at times approved by the building superintendent. It should list the make, type and size of each piece of equipment, and where it is to be located.

It should state that a first class installation is contemplated and that all work will be done in a neat and workmanlike manner, that all laws and ordinances will be adhered to and that no debris will be left on the premises.

Additional provisions are that all lines from which insulation is removed shall be reinsulated, that new pipe and fittings shall be equal in weight and quality to that in use in the building's system, and that all lines affected by the control installation shall be properly trapped and vented.

6. OPERATING TO SAVE HEAT

The number of persons employed in a building to maintain and operate its heating system has some relation to its size and to whether or not it has a heating plant on the premises or purchases steam. Some assumptions must be made in regard to these things and the reader, if considering a specific building, can make such modifications as are necessary due to its size or type.

An office building 100 x 150 x 150 ft high with district steam service is typical of many structures about the country. Such a building might have several heating zones, a temperature control system, and might employ a chief engineer together with two shift engineers; or a chief engineer, a shift engineer and a night watchman. It might have, in addition, a handy man or a carpenter and a pipe fitter. In any event it would be best to consider the day as being divided into three shifts; the first, from 4 a.m. to Noon; the second, from Noon to 8 p.m.; and the third, from 8 p.m. to 4 a.m. Such a schedule has the advantage of getting the morning shift engineer on the job early enough most mornings so that he can start bringing the building up to the right temperature at the start of business, which is his principal responsibility, and to hold it there.

The afternoon shift engineer's chief duty is to see that the right temperatures are maintained in the building until the close of business. There is some advantage in anticipating its close by shutting steam off a short time ahead, as the steam in the radiators will continue to furnish heat for the remaining period. As zones are vacated, he shuts off the heat or sets the control to do this and the cooling-off period begins. He must see that the temperature does not go too low for the cleaners. On extremely cold evenings it will be necessary to hold the building at the daytime temperature, as it could not be raised in temperature again in the morning.

In mild weather the cooling-off process will be so slow that it will be the night shift engineer or watchman, or even the morning engineer who follows him, who will see that the temperature does not go too low. On the colder nights the night engineer rather than the morning engineer will have to start building up the building temperature as more time is required for this process on these nights.

All that a zone temperature control does is to open and close a valve on a steam line at certain times as called for by a clock or thermostatic mechanism. What the engineer must do to operate efficiently with temperature control depends on how nearly automatic his equipment is. With one simple type, the engineer selects the proper cycle to suit the weather. The outdoor temperature must be observed and the cycle changed as it becomes warmer or colder. In another type thermostats for night and day use are located in a key room. The engineer

must select the time to allow the building to begin to cool. He must also decide when heating-up must start. In buildings that are unoccupied at night he is enabled after observing the temperature trend outdoors and the weather forecast to do this before leaving for the night by setting a pin on a clock.

Another type has an outdoor thermostat and mechanism which automatically turns steam on at the right time for heating-up; the hour depending on the weather.

Still another type has thermostatic bulbs located both outside and inside.

Control panel boards should have doors which can be locked so that only the engineers can change the settings.

On rare occasions an increase in steam consumption may actually take place in a building when control is installed. However, this can only happen when there previously was underheating and discomfort. If, for example, a store, previous to the installation of control, was not heated at night in order to save cost but was heated-up each morning by the first employee turning on steam, then there would be a smaller steam use but discomfort each morning. With control, steam would come on at the right time, there would be comfort, but there also would be a greater steam consumption.

Instruments

One of the principal instruments needed for economical operation of a building, to supplement such forecasts as may be secured from the Weather Bureau, is a recording thermometer. This instrument should be set up at a convenient spot near the engineer's desk with the bulb outside the building in such a position that its recordings will not be affected by hot air, heat from the building, or the sun's rays. In a building having no control or the type of control with which the engineer must decide when steam shall be turned on for the morning heating-up period, the temperature trend as indicated on the chart will be useful to him.

For recording interior temperatures, the engineer should have one or two self-contained recording thermometers with locking doors. These may be placed in rooms if there are complaints of low temperatures. Study of the chart shows when windows were opened and other changes such as heat coming on.

He should have an 8 in. metal-protected, glass, indicating, mercury thermometer—a reliable instrument with which to compare other thermometers about the building—one which tenants will agree is accurate.

For comparing temperatures in rooms, one above another fed by a single riser, he should have a dozen inexpensive thermometers. These may be the 5 and 10 cent store variety so they will not disappear. Before setting them out, they should all be hung in a row in a room at 70F. Their readings should then be compared with that of the mercury thermometer and how much above or below the proper temperature each reads noted on its back.

An immersion thermometer should be installed in the return line to indicate the temperature of the condensate returning from the system. A rise in this reading indicates steam leaking through a trap or traps into the return lines. Where there are several zones, readings from thermometers in each will enable the engineer to trace the leakage to a particular zone.

Meters or other means of measuring the fuel used during each shift and each day are indispensable in operating a system economically, for only by the use of some such measuring equipment can it be told when changes are made whether or not conditions have been improved.

A pressure gage should be installed in the boiler header or service main to indicate steam pressure.

Where there is a boiler on the premises supplying steam, other important accessories are the water gage, water column, and safety valve.

Other equipment not often found are the sling psychrometer for determining relative humidity, smoke chart for determining density of smoke, Orsat apparatus for analyzing flue gases, and scales for weighing chemicals in water purification.

Inspections

A shift engineer can learn almost as much about how well he is operating his building by making routine inspections, as he can by observing the instruments in the basement. By inspections of the building from outside repeated daily at, for example, 11 a.m. and 3 p.m., the engineers soon learn in what rooms windows are consistently being opened. Experience shows that windows are very seldom opened by room occupants because they want more air. It is usually some one who is overheated who opens the window. If an orifice is already in the radiator inlet, replacing it with one of slightly smaller opening will decrease the room temperature and the window opener probably will forget to open it. When a check on temperatures can be taken this is of interest.

There are persons who do not yet believe that ordinarily enough air leaks in around windows for ventilating purposes. Such a one may complain unjustly if he can not immediately heat up his space after chilling it. The engineer should feel confident from the fact that his tenants generally, with control, have more comfort than they have had before and a saving is being made.

Where there is any possibility of things going wrong on the roof, periodic inspections of that location should be included.

The most important inspection of the day should be one of the building interior made either by the shift engineer or the night watchman as soon as possible after rooms are vacated. Where there is no shift engineer or night watchman, the night superintendent or person in charge of cleaning and his helpers have this very important task to perform. This inspection should be thorough in order that everything will be in order for the night and for the start of business the next day.

Form H (page 46) is a check list of items about the windows, doors, openings and radiators to be noticed. All things suggested can not be done in all rooms. It may not be feasible to close the shutter or pull the shade in some areas, or to lock certain doors. Some tenants might object to the removal of a simple window ventilator. The writer recalls inspecting an office one time where the tenant had a leather strap across his armchair, held in place by a padlock. A sign on the strap read "Don't sit on this chair." To move that chair would have been equivalent to robbing the First National.

On cold nights it may be necessary to keep steam on in some radiators in vacant rooms where there is a possibility of water lines freezing. Some renting agents do not approve of the economical practice of keeping steam turned off in such areas, desiring that they be warm in case prospective tenants want to see them.

The report or log of the evening inspection should list all irregularities requiring the attention of the carpenter, pipe fitter or handy man.

An early morning interior inspection should also be made by the morning shift engineer. This need not be a detailed inspection. The purpose of the morning engineer in looking over the building is simply to see that the temperature control is not heating up the building too fast. It should never be too slow or there will be complaints. If it is too fast it can be slowed down. Knowing what the outdoor temperature is and whether or not there is a wind, the engineer, by looking at thermometers about the building, can estimate whether or not he can retard the heating up. As mentioned, many temperature control systems now are designed so as to turn heat or steam on at the right time in the early morning. These are a great aid to comfort, especially in buildings having no night forces. Engineers in buildings so equipped will nevertheless want to make a morning inspection to see what conditions are and to familiarize themselves so they will know what they should be, in case some morning it is necessary to operate by hand.

FORM I. OPERATING ECONOMY CHECK LIST

1 Prevent the entrance of cold air through: Storm sash; Windows; Doors; Ventilating fan openings; Transoms; Window ventilators; Trap doors; Wall and roof openings
2 Run ventilating fans only when needed and no faster than necessary
3 Clean windows on warm days, in non-business hours and with doors from room closed
4 Decrease transmission losses by pulling shades down and keeping shutters closed
5 Heat to no higher temperature than necessary
6 Turn steam off wherever and whenever not needed; especially in vacant rooms
7 Turn steam off at the main or zone valves rather than at the radiators
8 Turn valves either entirely off or entirely on
9 Carry a low pressure on steam system; a high vacuum on vacuum system
10 Do not heat up the system for a few persons, lend them electric heaters
11 Carry on a regular schedule of maintenance

In general:

12 Study methods of heat saving, sources of building heat loss, heating and ventilation system operation and peculiarities of tenants
13 Instruct and arouse enthusiasm in building employees
14 Prepare a valve operation schedule for hand control: For use if there is no automatic control, or for use in case of a failure of control to function
15 Make periodic inspections from the outside, on the roof, through the building and in the basement
16 Keep daily records of fuel use, degree-days, wind, rain and difficulties
17 Investigate, analyze and correct conditions about which complaints are received
18 Make adjustments when possible in non-business hours
19 When in doubt secure advice from: Local steam utility, heating engineer, control contractor, or heating contractor of ability

Boiler Plant

In buildings having their own steam plants, the forces should keep the generating equipment in good condition and clean.

The fuel that gives the best results, cost considered, should be used. Fuel should be supplied to the boiler evenly and therefore stoker firing will produce better results than hand firing. A better contact with the air is to be had.

If oil or gas is used, burners should be kept clean and in adjustment.

Engineers should see that enough air is taken into the combustion chamber, so that smoke does not issue from the stack, as this is not only a nuisance but a loss as well. On the other hand they should see that not too much air is taken in, for this too results in a loss by cooling the hot gases that transfer heat to the boiler and water in it.

Operating Records

Records should be made daily of the steam or fuel use, the degree-days and other weather conditions and in addition of special conditions about the building affecting heating and of complaint calls. Copies of daily logs and of reports of the handling of calls should be sent to the building superintendent, rental office or owner.

Form I is a check list dealing with operating economy.

Maintenance

Maintenance operations should be carried on daily so that there will be an equitable distribution of work. More can usually be accomplished in the summer than at other times. It is often best to make changes in equipment at night if done during the heating season.

The owner will be amply repaid by having the control equipment checked over each year by the control manufacturer before the start of the heating season.

Window Cleaning

Windows opened for cleaning let in a lot of cold air. The room and its occupants are chilled and papers are blown about. When possible, window cleaning should be undertaken on mild days and if there are daylight times, such as week ends when there are few people in the building, this is the best time for this work. With intermittent heating controls there may be some dissatisfaction if the off period begins while the room is chilled and there is no heat available. This can be remedied by supplying extra steam to the zone by hand, but it will overheat other locations in the zone. While at work the window cleaner should see that openings, such as doors and transoms, from the room to adjacent areas, are closed so as to isolate the effect of the window opening.

Handling of Complaints

Shift engineers should be instructed so that they are capable of investigating, analyzing and correcting legitimate complaints of building occupants. They should go about this in a business-like way and with a little showmanship properly to impress the tenant. Loquaciousness is not necessary or desirable; not that it is desired to conceal anything, but the average tenant really knows very little about heating and may get a false impression of conditions. What he usually wants is simply comfort without effort. Tenants have to be studied. There are radiator feelers who know it is cold without looking at a thermometer—just by feeling the radiator. Tenants in buildings having control, who turn off their radiators, should be advised not to do this.

No Priorities Needed

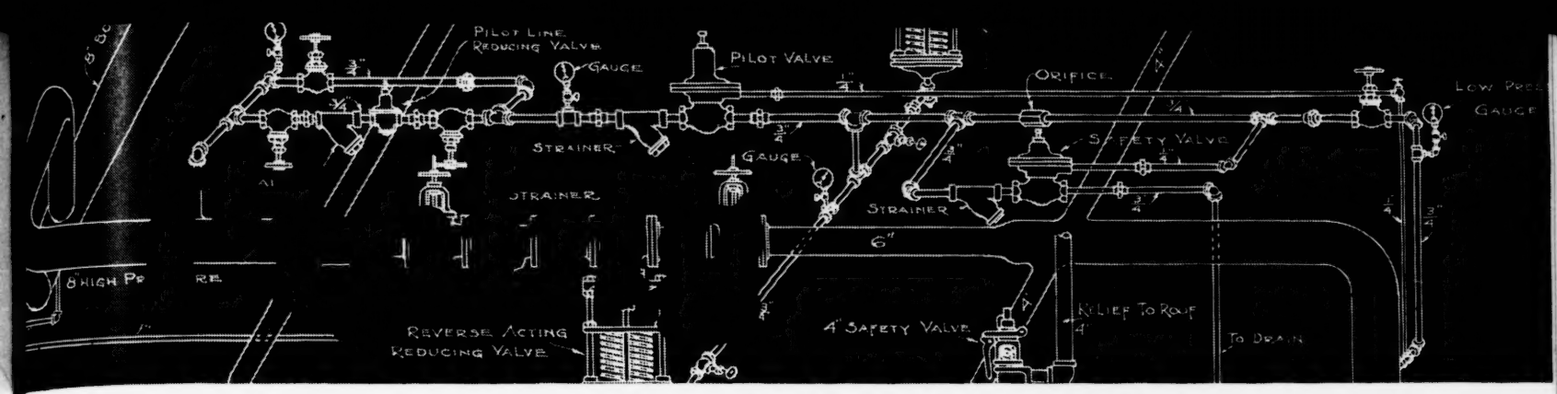
Early in this article it was stated that due to the rapidly changing picture as regards the obtainability of materials, the scope of the article would not be limited to a discussion of things that could be done with what then could be secured, but that all phases would be mentioned because other equipment might be for sale later. Of the suggestions that have been offered to save heat there are a number that can be carried out without the use of material. For emphasis these are repeated.

Disconnect unused or unneeded lines and radiation
Prevent overheating by adopting a schedule of valve operation
Keep steam turned off wherever and whenever unneeded
Turn steam off at the main valve instead of at the radiator
Be sure that valves are turned off tight
Remove radiator shields, covers and water pans if they cause underheating
Relocate furniture obstructing flow of heat to the room
Do not heat up the building for just a few persons, supply electric heater
Start janitorial work immediately after business hours
Proceed with cleaning by zones
Keep windows, transoms, doors and other openings closed
Clean windows in non-business hours
When cleaning windows, keep doors to adjacent rooms and halls closed
When feasible pull shades down and close shutters
Use ventilating fans only when absolutely needed
Maintain the system as well as possible
Make periodic inspections
Keep daily records
Instruct the building personnel on how to save heat
When in doubt, ask advice

District Steam Service

The greatest savings are made by checking steam use constantly against degree-days. The average decrease in steam use is probably over 20%. The best way to supply steam is by the use of temperature controls in a system prepared for it. In the opinion of the writer, control works more satisfactorily with district steam service than with a boiler. Therefore, if district steam service is available, its use would be a big step forward in the saving of fuel.

A final point that should be remembered is that the greatest amount of fuel that can be saved is simply the difference between what has been used and what is needed. Therefore, from buildings that have been badly operated, the greatest savings may be expected. The good operator should not be disappointed if his percentage of saving is not so great as his neighbor's, if his use per thousand cubic feet is low for buildings of the same class.



The Welding of Piping—II

By ARTHUR N. KUGLER

Mechanical Engineer, Applied Engineering Dept., Air Reduction Sales Co.

Welding of Steel Pipe

Through the years of development two standard procedures have been evolved for the oxyacetylene welding of steel pipe. The first, and perhaps older method, forehand welding (Fig. 9) may be defined as that procedure in which the torch flame and welding rod are so disposed in the vee that the torch flame points ahead in the direction of welding and the welding rod precedes the flame. To secure proper penetration and fusion, opposite oscillating movements are imparted to both the torch and the rod in semi-circular patterns. The newer method, backhand welding, Fig. 10, may be defined as that procedure in which the torch flame and welding rod are so disposed in the vee that the torch flame points back at the completed weld and the welding rod is interposed between. In backhand welding it is not necessary to resort to the complicated oscillating motions. Hence, the welding vee may be narrowed from 90° to 75°. This simplification of the procedure minimizes the opportunities for oxidation of the weld metal and therefore yields deposits of higher physical properties. The continuous protection of the outer envelope of gases playing over the newly deposited weld metal serves to protect it further and also to retard the cooling.

The inherent advantages of backhand welding make it the preferred process for all pipe welding. It should not be inferred from this, however, that forehand welding is not or should not be used. On the contrary, conditions arise in almost every job where forehand welding would be the only solution to welding a joint in a difficult place. Therefore a really competent pipe welding operator should be skilled in both techniques. On the other hand, it is generally conceded that backhand welding is the only way to make a successful vertical pipe position weld.

In oxyacetylene welding by either forehand or backhand technique the selection of proper filler material will have a marked influence on the results obtained in the final weld. The old, conventional mild steel welding rod, while satisfactory for some classes of service such as low pressure work, is not as economical to use as the alloy steel rods which have been developed in the last ten years. The tensile strengths obtainable with the simple mild steel rod (carbon—.06, manganese —.25) will range from 45,000 to 50,000 psi. The elongation will range from 15% to 20%. With this rod it will be very difficult to secure sound welds free of porosity. With the alloy rods, on the other hand, the tensile strength will range from 60,000 to 70,000 psi, and the elongation will be 20% minimum and range up as high as 30%. Further, the weldability of this alloy rod is vastly superior to that of the simple mild steel and the difficulties with porosity are virtually eliminated.

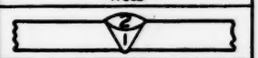
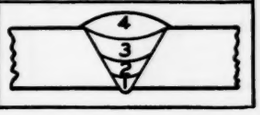
If backhand welding in a narrow vee (75°) is combined with the use of the alloy rod, greatly increased welding speeds are obtainable. The speeds may be as much as 50% to 75% greater than those obtainable with forehand welding on a 90° vee with the mild steel filler metal. Even in forehand welding the use of the alloy steel welding rod will result in faster welding speeds, principally because of the better weldability of the alloy steel and the fact that excessive working of the weld metal is unnecessary to eliminate porosity.

From this discussion of the relative merits of the two welding procedures and the types of filler metal it may be reasoned that for best physical properties and best welding speeds, backhand welding in a narrow vee with an alloy rod should be used wherever practicable.

Multi-Layer Oxyacetylene Welding

Single layer welds of the above properties may be made on pipe wall thicknesses up to about ⅜ in. When the wall thickness of the pipe exceeds ⅜ in. the size of weld required makes it difficult, with single-layer welding, to secure proper root penetration and thorough fusion throughout the weld cross-section. To simplify

TABLE 2. RECOMMENDED NUMBER OF LAYERS FOR DIFFERENT THICKNESSES OF PIPE.

RANGE OF PIPE WALL THICKNESS	NUMBER OF LAYERS	METHOD OF DEPOSITING	CROSS SECTION OF WELD
3/8" TO 5/8"	2	TWO LAYERS ONE PASS	
5/8" TO 7/8"	3	THREE LAYERS TWO PASSES 1 & 2 IN ONE PASS LAYER 3 ONE PASS	
7/8" TO 1 1/8"	4	FOUR LAYERS THREE PASSES 1 & 2 IN ONE PASS LAYERS 3 AND 4 IN TWO PASSES	

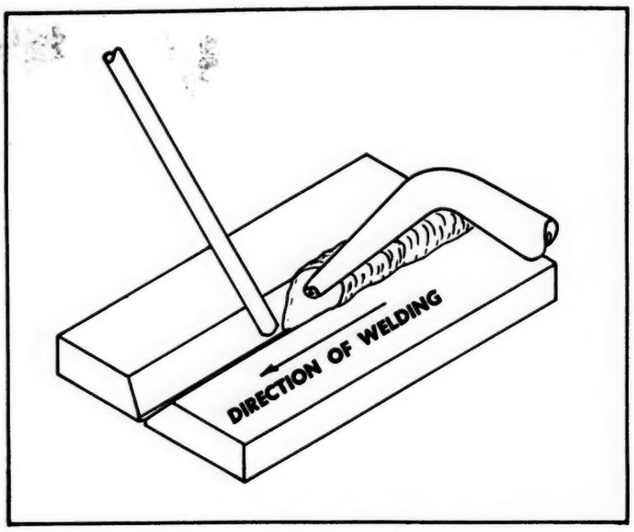


Fig. 9. Forehand welding.

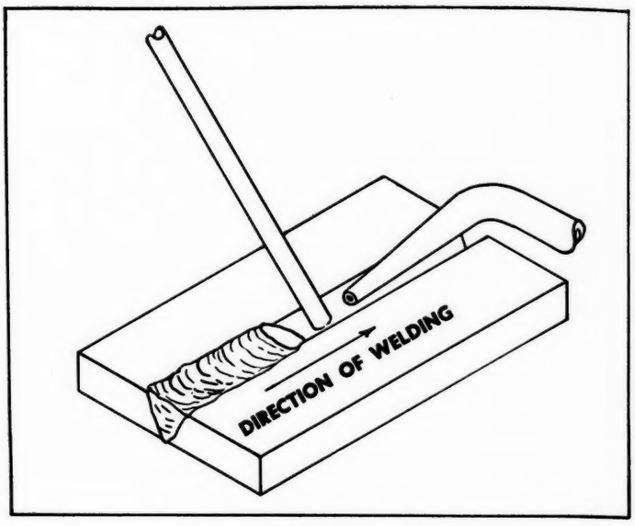


Fig. 10. Backhand welding.

the oxyacetylene welding of heavy wall pipe, there was developed several years ago the multi-layer oxyacetylene welding technique[2]. In this method the weld is made in two or more layers, depending upon the pipe thickness. Thus, for pipe ranging from 3/8 to 5/8 in. two layers are used; from 5/8 to 7/8 in. three layers; from 7/8 to 1 1/8 in. four layers, etc. For plain carbon steel each layer should range between 3/16 and 1/4 in. thickness. Table 2 shows the recommended number of layers for different thicknesses of pipe. In Fig. 11 is illustrated the cross-section of a typical multi-layer weld.

Multi-layer welding, contrary to what one might assume at first glance, is faster, less costly and yields higher quality welds than equivalent single layer welds. These advantages are achieved through the simplification of the technique. The operator in depositing the first layer of weld metal is in effect welding approximately 1/4 in. thick steel. This in itself is a relatively simple operation and he may therefore devote his entire attention to securing proper penetration and thorough fusion without icicles. Having thus sealed the root of the vee it is no longer necessary to worry about burning through. All attention on subsequent layers may be devoted to securing complete fusion to the previously deposited weld metal and the side walls of the vee. Obviously the welding of these thinner sections progresses at relatively high rates of speed. The overall speed on the completed joint shows that a cost saving of 15% to 20% is effected by the use of multi-layer welding. The improvement in weld quality is also a reflection of this simplification of technique, and further, is a result of the heat treating effect of depositing the upper layers of weld metal on the lower. The subsequent layers of weld metal reheat the previously deposited metal through the critical range, thus refining the grain structure and yielding welds of higher ductility. Either forehand or backhand welding may be used for multi-layer welding but obviously the inherent advantages of backhand welding indicate this to be the preferred process.

[2]Rooke, R. M., F. C. Saacke and A. N. Kugler: Multi-layer Oxyacetylene Pipe Welding, Parts I and II. The Welding Journal, October, 1936, 2-12.

Modern power plants operating at high pressures and in some cases at high temperatures, would be practically impossible without the welding processes for joining the pipe. High pressure pipe obviously involves heavy wall piping and requires the use of multi-layer welding. The use of alloy steel welding rods for this work is imperative to secure high quality joints. If, in addition to high pressure, the system must operate at high temperatures, this added condition requires the use of special alloy steel. It has been found that by the addition of 0.50% molybdenum to the usual mild steel analysis used for Grade B pipe, the yield strength and the creep strength of the steel at elevated temperatures will be increased. This permits the use of lesser wall thicknesses for these severe conditions. However, the welded joints on this alloy steel pipe must be of substantially the same analysis as the base metal in order that the system may have uniformly high strength at elevated temperatures. Oxyacetylene welding rods[3, 4] of such alloy analysis are now available and in use by the piping industry for the oxyacetylene welding of carbon molybdenum steel high-pressure high-temperature piping. For the heavier wall thicknesses, obviously, multi-layer welding is used. However, in the application of multi-layer welding to carbon molybdenum steel pipe, it has been found desirable to reduce the thickness of the individual layers to the order of 5/32 to 3/16 in. In this manner the best physical properties of the deposited metal are achieved.

In the welding of all high pressure piping and more particularly carbon molybdenum steel piping, it is necessary to submit the welded pipe joints to some form of stress relief to avoid locked up stresses. The conventional procedure is to heat the weld and adjacent pipe material for a distance not less than six times the thickness of the pipe to a temperature ranging from 1150 to 1250F. This temperature is maintained

[3]Rooke, R. M., F. C. Saacke and A. N. Kugler: Oxyacetylene Welding of Carbon Molybdenum Steel Piping for High Pressure, High Temperature Service, Parts I and II. The Welding Journal, August, 1940, 553-567.

[4]Seabloom, Eric R.: Discussion of Messrs. Rooke, Saacke and Kugler's paper entitled "Oxyacetylene Welding of Carbon Molybdenum Pipe for High Temperature, High Pressure Service." The Welding Journal, September, 1940, 639-641.

in the ratio of one hour per inch of thickness. The rates of heating and cooling the assembly are carefully controlled. Heating may be supplied by electric resistance or induction units or through the medium of petroleum fuel gases and air. Regardless of the process employed, sufficient and adequate instruments should be utilized to permit of control of the rate of temperature increase or decrease and for checking maximum temperature achieved and held. This procedure is expensive and usually the cost can be absorbed only on large jobs. However, on smaller installations or where a relatively small number of joints are involved, it has been found desirable to use the oxy-acetylene flame for this stress relief treatment. Obviously the above procedure can be followed but it is somewhat expensive and time consuming. Tests have been conducted which indicate conclusively that a short time procedure may be employed with equally effective results. In this short time technique the joint and adjacent pipe area are heated to a temperature of 1500F, using one or more torches and if necessary a multiplicity of flames on each torch. The primary object of this heat distribution is to achieve a uniform heating of the entire joint. The temperature may be checked by thermo-couples, pyrometers or thermometric pellets. Once the temperature has been reached, heating is stopped and the joint is wrapped with asbestos paper, blankets or blocks. If the pipe ends are open, they are plugged to prevent internal drafts. After covering, the pipe joint is allowed to cool slowly. The tests of this type of stress relief indicate that a very satisfactory grain refinement is effected and this naturally is reflected further by the improvement in the ductility in the weld deposit.

Braze Welding Galvanized Steel Pipe

Galvanized steel pipe is extensively used in industry to resist the inroads of internal and external corrosion. When galvanized pipe is assembled with screw threads and fittings, the operation removes the galvanizing from the steel pipe. In addition, the threaded interiors of the fittings also lack the galvanized protection. Obviously these areas form the weak link in the chain, and corrosion rapidly eats through at these points. Years ago, attempts were made to weld galvanized pipe with steel filler metals employing both the oxy-acetylene and metal arc processes. In these trials it was found that the heat of welding burned off the zinc coating in the region of the weld for a distance of about one inch on each side. Various methods were tried to replace this damaged coating, among which was that of heating the joint and rubbing it with half-and-half solder. These efforts unfortunately were not entirely satisfactory. Still later, the braze welding technique employing standard dry flux was attempted. Here again, it was found that the heat of the braze welding operation left a very narrow zone between the edge of the braze deposit and the unaffected galvanized coating, which zone was exposed to the action of corrosive media.

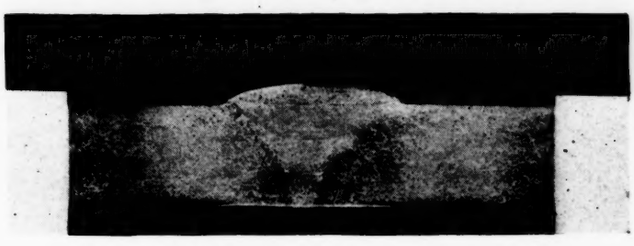


Fig. 11. Multi-layer weld on carbon-moly pipe (⅞ in. thick, 4 layers).

Within the last several years there has been developed a new type of flux for braze welding[5] operations which affords better control of the process. This new flux is provided in a semi-liquid paste form and is painted on the joint both in the vee and for a distance of an inch or more along the side of the vee, internally and externally. In addition, the rod is dipped into the liquid flux, or, if desired, the rods may be purchased with the same flux coating applied by the manufacturer. The composition of this flux is such that under the heat of the brazing operation, it operates to control the volatilization of the zinc coating on the galvanized steel and, in addition, the zinc content of the brass rod. In performing the former function it prevents the zinc from being burned off the pipe surfaces and thereby preserves, in the joint, a corrosion resistance equal to that of the unaffected pipe itself. In performing the second function, the flux reduces the porosity in the weld deposit to a negligible amount, thereby resulting in braze welds of high density, tensile strength and ductility. These braze welds, made with the manganese bronze type of rod, develop tensile strengths ranging from 60,000 to as high as 74,000 lb per sq in.

The development of this liquid flux makes it now possible to braze weld galvanized steel pipe joints and have the entire assembly withstand corrosive action as well as plain galvanized steel does. In addition, these joints possess strengths equal to that of the steel pipe material. This method of fabrication has found extensive use in the air conditioning industry for the installation of refrigerated circulating water lines.

Arc Welding

Arc welding techniques have been developed in the past decade to the point where weld deposits equal and often exceed the physical properties of the base metals joined. These excellent results have invariably been obtained with the use of the shielded arc electrode. These shielded arc coatings are designed to perform one type of function particularly well. In some cases a given coating type may also perform other functions quite satisfactorily. However, for best results from the point of view of economy and quality, it is a wise precaution to study the various types of arc welding electrodes and select the one best suited for the work on hand. The American Society for Testing Materials Specification, Serial Designation A233-40T, provides an excellent source of information on the various types of electrodes.

For the contractor whose work is solely in a shop where the pipe sections may be rotated and welding performed in the flat or downhand position, the E6020 and E6030 electrodes, as covered in the above specifica-

[5]Forgett, Valmore: Brazing Galvanized Steel Pipe. Steel, July 24, 1939, 50.

tion, are to be recommended. The E6020 electrode is specifically designed for the depositing of horizontal, non-position fillet welds; that is to say, if one leg of the fillet is horizontal and the other vertical this type of electrode when properly manipulated will give a fillet weld with equal leg dimensions and a flat to concave surface. For depositing butt welds in the flat position the E6030 electrode should be used. It is appropriate to point out here that, if the fillet weld is positioned as a vee weld, an electrode designed for welding in vees is to be preferred over the type recommended for non-positioned fillets. Both of these electrodes are sometimes referred to by welding operators as "hot rods." They receive this designation from the fact that generally they will operate at higher currents than the same diameters of shielded arc electrodes which are designed for all-position welding. The reasons for their ability to handle higher currents are attributable first, to the composition of their coating, which is of a mineral nature, and, second, to the quantity of coating applied. Deposits with these electrodes will possess very high physical properties and in addition will be capable of passing X-ray examination. Further, deposition rates and welding speeds will be the highest obtainable with any type of electrode. It should be obvious therefore that for shop work these electrodes are unquestionably the best.

As in the case of shop fabrication of welded piping, where we have electrodes specifically designed for the task, so for field use we have electrodes specially adapted for the conditions peculiar to the installation of piping power plants, process systems and heating layouts. The E6020 and E6030 electrodes which proved so efficient under shop conditions, would hardly be of value when that same piping must be welded on the job. In the first place, it will not generally be possible to rotate the piping to obtain a flat or downhand weld. Instead, welding must be performed in all positions with the pipe held stationary. Thus the field operator will encounter vertical pipe position welds and overhead fixed position welds. For this class of welding it is necessary to use an electrode designed to deposit metal in the horizontal, vertical and overhead positions. Such electrodes are covered by the classifications E6010, E6012 and E6013. According to the specifications, the E6010 electrode is required to develop the highest ductility and, in addition, to deposit welds capable of meeting the X-ray requirements in all positions. Therefore, for power piping installations involving plain carbon steel, the E6010 electrode is to be preferred for the reason of its higher physical properties. The E6012 and E6013 electrodes deposit welds of somewhat lower physical properties, but have certain operating characteristics which make them particularly desirable on many jobs. These electrodes can be used with complete assurance on low pressure systems. In addition, if conditions are such that the fit-up of the joints is not perfect, an electrode of the type of E6012 will give the operator better results from the point of view of ease of application than any of the other types. Moreover, if it is necessary to fabricate tee connections where fit-up is not always the best, this electrode again offers definite advantages.

The question as to whether to use direct current or alternating current for pipe welding is today largely answered by the availability of machines. The electrodes discussed earlier in many instances may be used with either type of current. For example, the E6020 or E6030 electrodes for shop work provide equally satisfactory results with either a.c. or d.c. machines. It is well known that with direct current, particularly in deep vee or deep "U" groove welds, arc blow or magnetic blow is a particularly annoying condition. This condition can be practically eliminated by the use of a.c. machines. It would appear therefore that alternating current equipment has definite advantages in shop welding. For field welding, only the E6012 and E6013 electrodes are suitable for all position a.c. welding. As a matter of fact the E6013 electrode is specifically designed on all position a.c. work, whereas the E6012 electrode has been designed more for d.c. straight polarity operation. In field work, selection of a.c. or d.c. equipment will be largely dictated by the requirements of the job as measured in physical properties of the weld deposit. If the highest physical properties are necessary, then the E6010 electrode and d.c. welding must be used. If, however, the somewhat lower physical properties of the E6013 electrode are acceptable, then a.c. welding may be used in field work. It should be appreciated, however, that welding in all positions with alternating current is not quite as easy an operation as welding in all positions with direct current.

High Pressure Piping

High pressure steam power piping has been referred to already under the oxyacetylene process. Present day power plants operating at pressures as high as 2800 lb per sq in. with temperatures up to 1100F could not exist without the welding processes for joining the necessary pipes. The bulk of these systems have been installed using the metal arc process. Alloy steels of the carbon molybdenum variety and the chrome molybdenum variety are used extensively. Since these alloys are used for specific properties it is vitally important that the electrodes possess these same alloy ingredients so that the weld may function in the same manner as the pipe metal. Thus, there are available carbon molybdenum and chrome molybdenum electrodes for the welding of these steels. Through the test of time these electrodes have proved themselves fully adequate for the service. Preheating employing electric resistance or induction methods is exceedingly important for the welding of these alloy steels. Also stress relieving, accomplished with the same electric equipment, is necessary to secure best results. As in the case of mild steel electrodes the carbon molybdenum electrodes available are grouped into two classes. The first class is that for all-position welding and is covered by the classification number E7010. This, obviously, is for all-position work in the field. The counterpart for shop work is E7020 electrode which is for flat position welding and may be used either with d.c. or a.c.

(Continued in next month's issue.)

POINTERS ON HOW TO CONSERVE EQUIPMENT

UNIT HEATERS

By C. A. Thinn, C. A. Dunham Company

Although this article is written for the express purpose of giving pointers to operating engineers on how best to maintain the unit heater equipment, so as to get the best possible performance and longest possible life, we believe that it may be to the advantage of the operating engineers to study the installation of heaters to see if they are installed at the best possible location for giving the most efficient heating service from the standpoint of air circulation and heat distribution. There are several types of unit heaters, so it is, therefore, difficult to prescribe any set rule or rules which would apply to all types of heaters. However, each type has its own application and its own method of installation.

The deflection at which the air is distributed over the room to be heated is, naturally, of importance in obtaining good performance, and to allow the engineer to make adjustments in this respect, most unit heaters are equipped with adjustable louvers. We recall one installation in which the unit heaters were located along the outside wall, blowing the heated air parallel to the outside wall and deflecting it down toward the floor. The air was thus circulated around the outside walls of the building, which, from a heating standpoint, might have been the deciding reason why the installation was made in this manner, without taking into consideration the comfort of the workers, who were all at work at benches along the outside walls or near the outside walls. Those workers located in the hot air stream were uncomfortable, of course, and when moving from this hot air to the cool air in the interior of the building they felt considerable discomfort. The result was that considerable complaints were made by the occupants to the management, until by adjustment of dampers and changing of the direction of the air flow, in some cases, desirable and improved results were obtained.

Most unit heaters are designed to secure the rated output at a steam pressure of 2 to 5 pounds. It would, therefore, be necessary in extreme cold weather to see to it that the heater was supplied with this steam pressure, and should there be some question about whether the heater was delivering the rated heating output, this could be checked up by feeling the radiators of the unit heaters to see if the entire heating surface was hot, and that there were no cool spots or sections, because in that event the heating output would be reduced accordingly. Cool spots or sections of a unit heater indicate that the air venting and drainage of condensation from the heater is not sufficient. It would, therefore, be a good idea for the operating engineer to investigate the venting equipment to see if it is functioning properly and is of sufficient capacity to handle the heater. If the capacity were found sufficient, then perhaps the trouble may be due to dirt, or other foreign substance, clogging the trap or the strainer before the trap, so that the air and condensate would not flow freely through the trap, or through the air vents. There might be stoppage in the piping on the return side of the heater, or this line was not sufficiently open to permit drainage freely. There might be back pressure in such line, which would also prevent free drainage of either air or water from the heater, and which, of course, would affect the heating output.

On every new installation there is a great deal of dirt and foreign substances lodged in the piping, and eventually, when steam is turned on in the plant, this works its way down to the various points where condensation is being drained from the piping or from the heaters; since the traps are usually located at these drainage points, the traps are often found to be loaded with dirt. Therefore, it is good management on the part of the operating engineer to plan a thorough cleaning of traps some time after the plant installation is completed, also at some

later date during the first heating season, and once each heating season thereafter.

Should the operating engineer discover that a unit heater has developed a leak, then he could have this heater taken down, or, if possible, repairs made in its position in the piping, either by welding or brazing, or soldering. Usually, however, there is not a great deal of maintenance on the unit heating elements.

A unit heater is equipped with an electric motor, switches and electric wiring, thermostats and relays, and consequently the electrical parts need attention from time to time to find and repair contacts which are inoperative or not functioning properly. These can be cleaned and new parts installed if needed. The motors need to be oiled regularly and the operating engineer should follow the manufacturer's instructions for oiling the motors, using a good grade of oil. On certain types of unit heaters the fan is supported in bearings and operated by belt from the motor. In such a case, an inspection of the belt should be made occasionally to see that it is in good condition, and is not too tight or too slack and allows the motor to pull the fan most efficiently. Fan bearings should be oiled regularly.

EXPANSION JOINTS (Slip Type)

By W. A. Schulmeister, American District Steam Co.

In the following 14 suggestions for obtaining better operation of expansion joints, the first seven cover installation, the last six cover maintenance:

1. Expansion joints must be installed so that the slip is aligned perfectly with the pipe to prevent cramping of the slip and uneven wear on the packing.
2. Guides should be used in long pipe runs to keep the pipe in alignment.
3. It is best to anchor the expansion joint or if this is impractical to anchor the pipe adjacent to the expansion joint. Rigid and strong anchors must be provided in the pipe line to direct the movement of the pipe to the expansion joint. Avoid anchors which may become loose and permit the pipe to slide.
4. Every expansion joint installation should provide ample working room and access to the packing glands.
5. If the pipe is likely to be exposed to colder temperatures than prevail at the time the joint is installed, the slip should be moved into the joint enough to allow for the maximum contraction which may occur, as otherwise all the fittings and anchors may be subjected to excessive strain.
6. Protect the slip surface during installation. A smooth slip is essential to reduce wear on the packing.
7. Joints packed for steam service should not be subjected to a hydrostatic test, as the packing will harden if water saturated.
8. It is important to choose a packing which is most serviceable for the particular fluid or gas on which it is to be used. Choose a good packing, not necessarily the most expensive. A packing which is good for saturated steam may not do too well on high pressure superheated steam and vice versa. Packing failures are frequently due to the use of an improper packing.
9. When expansion joints are packed at the factory, the packing is pressed into the stuffing box under cold conditions. Most packings will compress further when exposed to heat; therefore, it is imperative that the glands be drawn up gradually and uniformly immediately after the joints are put into service. If the joints are inspected and the glands adjusted periodically for a few days thereafter, a little each time, the packing mass will become so adjusted that little attention is required thereafter.
10. The glands must be drawn up uniformly to prevent binding and damaging the slips. Feelers should be inserted between the gland and the slip to make certain that the clearance is uniform all around the slip.
11. The resiliency of the packing may be destroyed by drawing up a packing gland too much at one time. The packing under those circumstances is forced into a hard mass and loses its efficiency.
12. It may become necessary to install an additional strand of packing after the joint has been in service and exposed to high temperature. A slight leakage of oil from the bottom of the stuffing box should not be mistaken for a leak; this may be lubricant squeezed out of the packing. This may occur when the joint is first put into service.

13. After the initial adjustment and when the packing has taken its permanent form, the subsequent service may be reduced to a periodical inspection and the injection of a lubricating compound through fittings provided on the joint. This lubricant keeps the packing pliable and the slip surface smooth. It is seldom necessary to make any further adjustments of the packing glands if the joints are serviced in this manner.

14. It is very important that any leaks through the packing glands are stopped immediately. If a leak is permitted to continue it may cut channels through both the packing and the slip and a satisfactory correction of this condition may require not only a new set of packing but a new slip.

COILS

By M. F. May, Young Radiator Company

A large percentage of the heating and cooling coils in service today are made from non-ferrous metals and with proper care should last for many years. New rulings by WPB regulate the use of copper, aluminum and similar metals and cause the coil manufacturers to turn to steel for use in manufacturing their products, even though steel also is on the list of critical materials. In the interest of conserving metals as well as economy for the building owner, coils should be properly installed and checked periodically to get the most efficient operation and longest life possible from them.

Some of these points to be checked are as follows:

1. Air filters should be used particularly where outside air is brought in. Filters help keep coils clean;

2. Periodically, depending on conditions, the outside surface of the coils should be cleaned, using either a compressed air line or water line to remove the dirt from around the tubes and fins;

3. All water cooling coils should be installed so that they can be completely drained in the winter. When the cooling season is over, all water coils should be drained, since fresh air dampers do not always close tight, and in freezing weather, unless the coils are drained, the water will frequently freeze and damage the coils, sometimes beyond repair;

4. Steam coils should always be installed with the tubes pitched towards the return, and the return line itself should be lower than the coils so that condensate can not back up into the coils when the steam pressure is down and thus cause waterline corrosion. Also, with intermittent steam pressure, when water is standing in the coils, there is a water hammer when the live stream hits this water which can result in considerable damage;

5. When steam or hot water heating coils are used for heating outside air brought in for ventilation or industrial uses, a constant steam pressure (or in the case of water coils a sufficiently high temperature and constant water circulation) must be maintained at all times when the outside temperature is below 32F to prevent freezing;

6. Automatic controls should be installed which will shut off the fan and close the outside air dampers when there is a failure of the heating medium as outlined in paragraph (5);

7. When hot water coils are used for heating outside air, care must be taken to insure the coils always being completely filled with water. One engineer advises the use of a standard low water cutoff located a little above the coils to stop the fan and close the outside air dampers if the water level in the system drops to that point. Freezing of the coils is prevented by stopping the fan and closing the outside air dampers before the water circulation in the coils stops due to the lower water level; and

8. Each installation should be carefully checked and analyzed by the engineer in charge to find the points in that particular system where trouble can occur and steps taken to correct them or at least watch them carefully to prevent damage to the coils.

All of the possibilities for trouble are too numerous to mention here, but the points outlined touch on the most serious causes for trouble and all engineers should take steps immediately to put their installation in first-class operating condition.

Fuel Oil and Burner Restrictions Tighten

By the latter part of May the Eastern Seaboard had settled down (but had not become entirely reconciled) to gasoline rationing, while the possibility of similar rationing for the mid-west resulted in more or less violent protests from that region and some of its representatives in Washington. The clamor of the associated discussions, criticisms, and defenses, coupled with the coming of mild summer weather, was such that not too much attention was paid by the public at large to the fuel oil orders issued in May.

These orders affected the 17 states on the eastern seaboard, Oregon and Washington, and (to a lesser degree) 15 midwestern states. Most seriously affected was Area 1 (see map), where fuel oil deliveries were ordered cut 50% from 1941 figures.

By the end of May indications were that oil-burning building owners were awakening to the implications of this drastic drop, although there was no indication that home owners were doing anything about it. Generally, however, the commercial and industrial building operators were much more aware, had already, as a group, made moves to protect themselves.

Assuming that the 50% cut is carried out this summer and next fall and winter, that a 50% cut means a 50% decrease in temperature differential, that a building is normally heated to 70F for the 24 hr period, and that next winter is a normal or average one, the results of the restriction in terms of inside temperature which can be carried will be somewhat as follows:

Boston	56.5F
New York	56.8
Baltimore	57.7
Washington	57.7
Syracuse	54.9
Atlanta	60.3
Philadelphia	57.3
Scranton	56.0
Providence	56.8
Portland, Me.	56.0
Seattle	60.7
Portland, Ore.	60.2
Jacksonville	64.4
Savannah	63.1
Newark, N. J.	56.7
Greensboro, N. C.	59.4

If the average temperature normally maintained inside had been 65F over the 24 hr period, then the inside temperatures possible would be 2.5F *lower* than those above. If 1942-43 is a colder winter than last, the possible inside temperatures would be still lower.

Noted here and there is the belief by some that the government is using this method to force more conversions back to coal, but that the restrictions are not necessary at all; in fact, apparently those who believe restrictions are necessary are in the minority. This is in sharp contrast to the statements of those in Washington concerned in any way with the order. Petroleum Coordinator Ickes has stated [May 19] that there is not a surplus barrel of light fuel oil on the East Coast; Deputy Coordinator Davies, concentrating on heavy oils, urges still further conversions of factories and commercial buildings to coal; an official of the Plumbing and Heating Branch, WPB, expressed himself and staff as worried over the failure of home-owners to convert to coal and anticipates "...considerable suffering in the East this winter." Addressing New England oil men May 27, Mr. Ickes said: "The plain and ugly truth, gentlemen, is simply this: There is no valid basis, as of tonight, for telling you that the petroleum supply situation on the East Coast is going to improve substantially in the immediate future . . . I ask you to join me—prudently—in preparing for the worst."

There is a marked tendency on the part of home-owners to claim that their boiler is designed for oil, cannot be converted. This does not check with Anthracite Industries Laboratory survey[1] which showed that only 11.2% of oil-burning units in anthracite-burning regions are "impossible to convert".

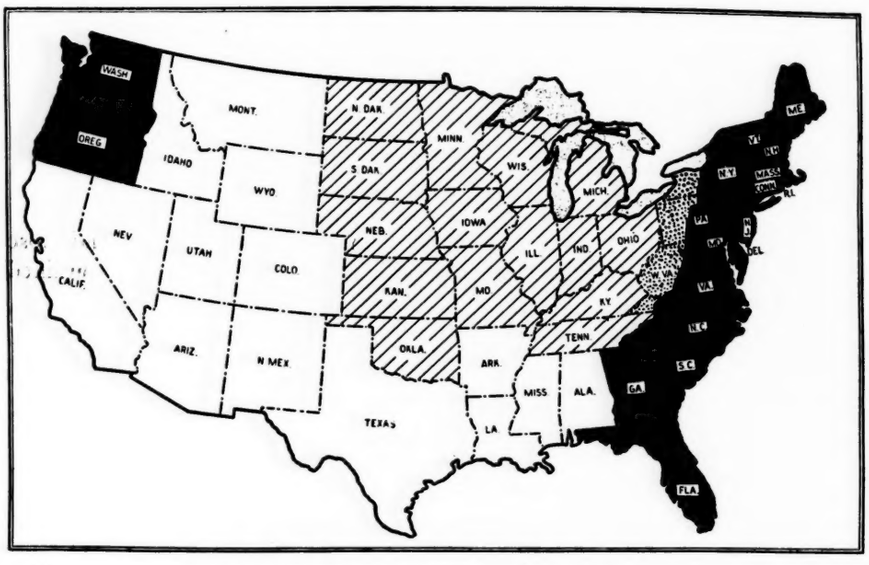
WPB has made available iron for foundries casting grates for conversion but very little business has resulted. If the oil restriction is not eased, and if conversions continue to lag, manufacturers and contractors report they will not be able to handle the conversions when the heating season arrives.

Over 13.5 million barrels of heavy oil are being saved annually on the East Coast by 368 large users who have converted. This is about 10% of normal consumption.

At that, the East Coast is not too badly off by comparison. On May 18 the Dominion of Canada announced that no oil would be available for heating in that country next winter.

The freezing of oil burners has resulted in hardships, particularly by small manufacturers because of inventory tie-ups. Defense Supplies Corporation, an RFC subsidiary, is considering a method by which DSC would purchase new mechanical oil burners produced prior to May 31. The proposition to the manufacturer would include cost of production plus cost of transportation, plus 4%. The manufacturer would pay DSC ½ of 1% per year to cover storage, insurance and rental costs.

Donald M. Nelson, chairman of WPB, on May 11 called on all consumers of coal to stockpile coal at once to the limit of storage capacity.



AREAS AFFECTED BY FUEL OIL RULES

Oil burner and fuel oil situation as of May 25. Area 1 comprises the black areas of 17 eastern states plus Oregon and Washington. Area 2 is the 15 mid-western states shown cross-hatched. Area 3 consists of the black plus dotted areas of the 17 east and northwest states. A 50% reduction in fuel oil deliveries, based on normal 1941 deliveries, is in force in Area 1 since mid-May. In Areas 2 and 3 no fuel oil may be delivered to burners installed after June 15 unless, for new construction, the foundation was completed prior to April 13 (Area 3) or June 15 (Area 2). Fuel oil will not be delivered for a converted burner unless conversion was completed prior to March 24 (Area 3) or June 1 (Area 2). Exception: "if consumer cannot use a fuel other than fuel oil, natural gas or mixed . . . gas. . . ."

[1]See HEATING AND VENTILATING, May, 1942, "Emergency Heating Plant Conversion from Oil to Coal," by Allen J. Johnson.

SHORT CUT HEAT LOSS ESTIMATING

TABLE 1. MULTIPLYING FACTORS FOR SHORT CUT HEAT LOSS CALCULATIONS

Type of Building	Major Qualifications	Minor Qualifications	Multiply Cubic Contents By†
Factories or Warehouses 65F Inside	One Story	Skylight in roof	5.8
		No skylight in roof	5.3
	No Skylights	Two story	4.3
		Three story	4.0
		Four story	3.8
		Five story	3.6
		Six story	3.4
Public Garages 60F Inside	All Walls Exposed	Skylight in roof	5.5
		No skylight in roof	5.1
		Heated space above	4.0
	Warm Party Walls on Both Long Sides	Skylight in roof	4.7
		No skylight in roof	4.4
		Heated space above	3.0
	One Long Warm Party Wall	Skylight in roof	5.0
		No skylight in roof	4.9
		Heated space above	3.4
Stores[1] 70F Inside	All Walls Exposed	Flat roof	6.9
		Heated space above	5.2
	Warm Party Walls on Both Long Sides	Flat roof	5.8
		Heated space above	4.1
	One Long Warm Party Wall	Flat roof	6.3
		Heated space above	4.7
Residences 70F Inside	For Entire Building[1]	No insulation	6.5
		With roof insulation only	6.0
		With roof and wall insulation	5.5
	First Floor Rooms[2] with Heated Space Above	No storm windows, no wall insulation	5.8
		All storm windows, no wall insulation	5.5
		No storm windows, walls insulated	5.5
		All storm windows, walls insulated	5.1
		Sun rooms and other rooms having an unusually large number of single windows and at least 2 exposed walls	10.0
		Sun rooms and other rooms having an unusually large number of windows, all storm windows, and at least 2 exposed walls	7.0
	Upper Floor Rooms[2] or Bungalow Rooms	Single windows, no insulation in ceiling, flat roof	7.3
		All storm windows, no insulation in ceiling, flat roof	7.0
		Single windows, insulation in ceiling, flat roof	6.5
		All storm windows, insulation in ceiling, flat roof	6.2
		Attic space above, single windows, no insulation in ceiling, eaved roof	6.8
		Attic space above, all storm windows, no insulation in ceiling, eaved roof	6.5
		Attic space above, single windows, insulation in ceiling, eaved roof	6.0
		Attic space above, all storm windows, insulation in ceiling, eaved roof	5.7

†Figures are in all cases Btu heat loss per hr per cu ft of contents. Factors apply only to inside temperatures listed in first column and to oF outside temperature.

[1]If building has bad north and west exposures increase heat loss by 10%.

[2]If room has bad north and west exposures increase heat loss by 20%.

Published by Heating and Ventilating, *148 Lafayette St., New York* 6/42

Copyright, 1942, by The Industrial Press

SHORT CUT HEAT LOSS ESTIMATING

The purpose of this sheet is to provide a quick method of estimating heat loss of buildings or of individual rooms accurate within 5% of the results obtained by longer methods. The method is such that it can be used by a service engineer where an estimate of radiation capacity is desired but where highly accurate calculations are not necessary at the time. It can also be used by other engineers for preliminary or checking calculations.

The method was developed by the engineers of a large utility company and reported by Alford G. Canar.

How To Use The Method:

1. Measure length, width and ceiling height, taking account of any shape of floor area other than one simple square or rectangle. Calculate floor area and multiply by ceiling height to obtain cubical contents.
2. Make a rapid scouting survey to observe what the prevailing conditions are so that the proper factor may be selected. See whether there are any party walls, heated space above, flat or eaved roof, storm windows, or skylights.
3. Select proper factor from Table 1 and Table 2.
4. Multiply cubical contents by the factor from Table 1 (and from Table 2 where necessary) and thus obtain the heat loss in Btu per hour.

For conditions in parts of the country where design temperature differentials other than 0° and 70° are customary the factors from Table 2 are applicable by multiplying the heat loss obtained by using the heat factors in Table 1.

TABLE 2.—CORRECTION FACTORS

Minimum Design Temperature	Correction Factor
+ 50 degrees	0.29
+ 40	0.43
+ 30	0.57
+ 20	0.72
+ 10	0.86
0	1.00
— 10	1.14
— 20	1.28
— 30	1.43

Published by Heating and Ventilating, *148 Lafayette St., New York* 6/42 *Copyright, 1942, by* The Industrial Press

Where Is the Sun?

By MAURICE J. WILSON and J. M. VAN SWAAY

Engineers, Carrier Corporation, Syracuse, N. Y.

IN the previous issue the charts for determining the sun's azimuth and altitude were presented for the months of January, November, October, March, September, May and July. Three charts, covering the remaining four months of June, April, August and December, are presented this month.

For convenience an additional example is worked out this month. Refer to Fig. 8.

Assume that it is desired to find the altitude angle and the azimuth angle of the sun at 4 p.m. in August for a 40° north latitude. Refer to the chart, Fig. 8, and note the construction lines. First, a line is drawn from the center to the intersection of the vertical 4 p.m. line and the elliptical 40° north latitude curve. The length of the line from the center to the intersection is 0.866 units, using as one unit the difference between the radii of the circles. A unit scale for convenience in measuring with dividers is shown in the lower right. Since the distance is 0.866 units this means that the cosine of the altitude angle is 0.866 and, consequently, the altitude angle is 30° — the angle whose cosine equals 0.866.

The azimuth angle is determined by extending to the azimuth scale the line between the center point

Fig. 8. Sun chart for April and August when the sun's declination is +11° 14'.

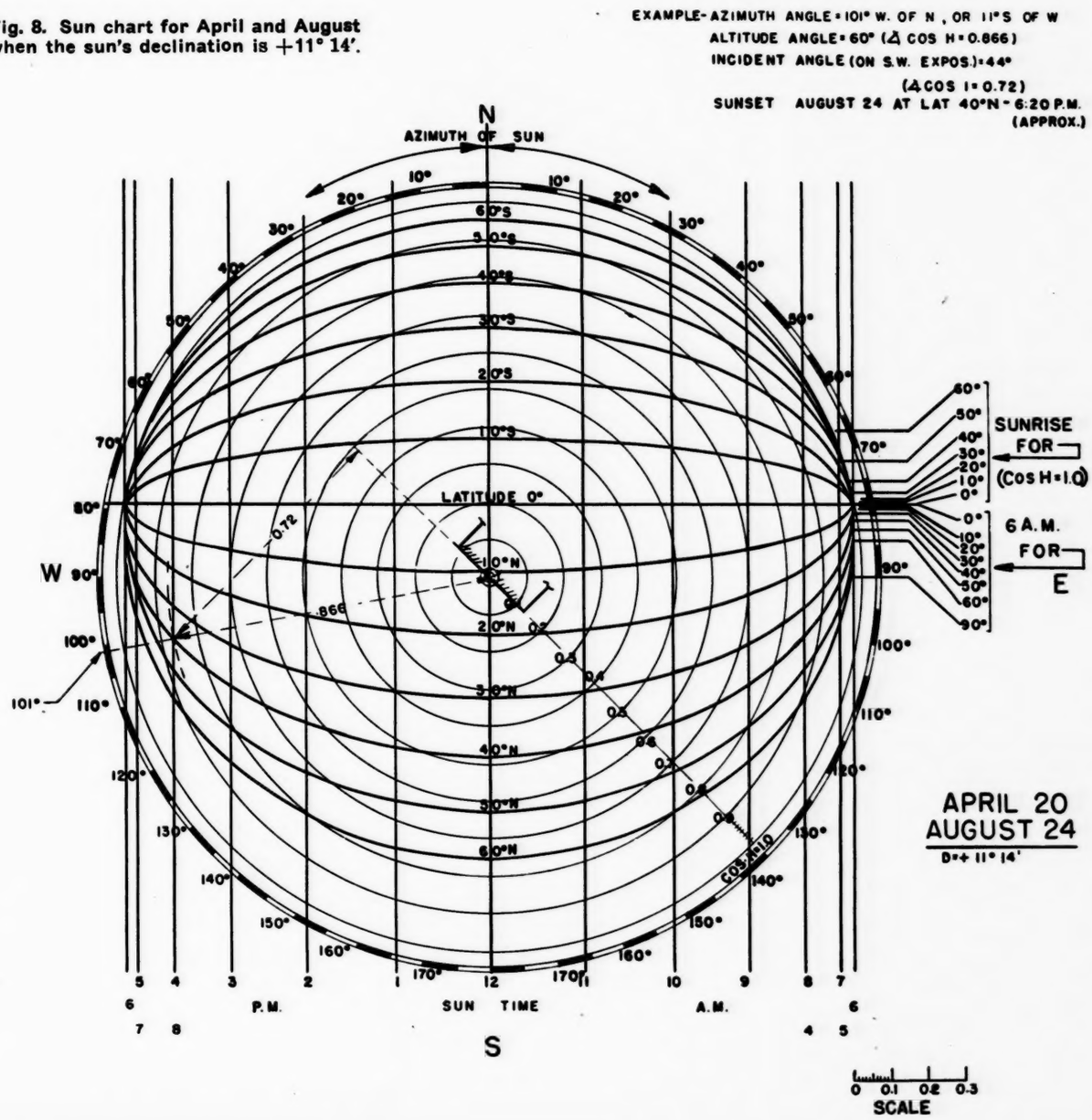


TABLE 3—TIME TO ADD TO OR SUBTRACT FROM STANDARD TIME TO OBTAIN SUN TIME

(E = Eastern, C = Central, M = Mountain, P = Pacific Standard Time)

City and State	Time to Add or Subtract, Minutes
Alabama	
Mobile	+ 8C
Montgomery	+ 15C
Arizona	
Phoenix	— 28M
Arkansas	
Hot Springs	— 12C
Little Rock	— 9C
California	
Los Angeles	+ 7P
Monterey	— 8P
San Diego	+ 11P
San Francisco	— 10P
Santa Barbara	+ 1P
Colorado	
Colorado Springs	0M
Denver	0M
Pueblo	+ 2M
Connecticut	
Bridgeport	+ 7E
Hartford	+ 9E
New Haven	+ 8E
Delaware	
Wilmington	— 2E
District of Columbia	
Washington	— 8E
Florida	
Jacksonville	— 27E
Key West	— 27E
Miami	— 21E
Georgia	
Atlanta	+ 22C
Augusta	— 28E
Macon	— 34E
Savannah	— 24E
Idaho	
Boise	— 45M
Pocatello	— 30M
Illinois	
Chicago	+ 9C
Springfield	+ 1C
Indiana	
Evansville	+ 10C
Fort Wayne	+ 20C
Gary	+ 11C
Indianapolis	+ 16C
Kokomo	+ 15C
Terre Haute	+ 10C
Iowa	
Burlington	— 5C
Cedar Rapids	— 7C
Davenport	0C
Des Moines	— 14C
Sioux City	— 26C
Kansas	
Topeka	— 23C
Wichita	— 29C
Kentucky	
Frankfort	+ 20C
Lexington	+ 22C
Louisville	+ 17C
Louisiana	
New Orleans	0C
Shreveport	— 15C
Maine	
Portland	+ 19E
Maryland	
Baltimore	— 6E
Massachusetts	
Boston	+ 16E
Fall River	+ 16E
Lowell	+ 15E
Springfield	+ 10E
Worcester	+ 13E
Michigan	
Battle Creek	— 41E
Detroit	— 32E
Grand Rapids	— 42E
Minnesota	
Minneapolis	— 13C
Mississippi	
Jackson	— 1C
Vicksburg	— 3C
Missouri	
Jefferson City	— 9C
Kansas City	— 18C
Springfield	— 13C
St. Louis	— 1C
Montana	
Butte	— 30M
Nebraska	
Lincoln	— 27C
Omaha	— 24C
Nevada	
Carson City	+ 1P
New Jersey	
Atlantic City	+ 2E
Camden	+ 1E
New Mexico	
Santa Fe	— 4M
New York	
Albany	+ 5E
Binghamton	— 4E
Buffalo	— 16E
New York	+ 4E
Poughkeepsie	+ 4E
Rochester	— 10E
Schenectady	+ 4E
Syracuse	— 5E
Utica	+ 1E
North Carolina	
Raleigh	— 15E
North Dakota	
Bismarck	— 43C
Ohio	
Cincinnati	— 38E
Cleveland	— 26E
Columbus	— 32E
Dayton	— 37E
Sandusky	— 31E
Toledo	— 34E
Youngstown	— 23E
Oklahoma	
Muskogee	— 21C
Oklahoma City	— 30C
Oregon	
Portland	— 11P
Salem	— 12P
Pennsylvania	
Easton	— 1E
Erie	— 20E
Harrisburg	— 8E
Philadelphia	— 1E
Pittsburgh	— 20E
Scranton	— 3E
Rhode Island	
Providence	+ 14E
South Carolina	
Charleston	— 20E
Columbia	— 24E
South Dakota	
Pierre	— 41C
Tennessee	
Memphis	0C
Nashville	+ 13C
Texas	
Austin	— 31C
Dallas	— 27C
El Paso	— 6M
Galveston	— 19C
San Antonio	— 34C
Utah	
Salt Lake City	— 28M
Virginia	
Norfolk	— 5E
Richmond	— 10E
Washington	
Olympia	— 12P
Seattle	— 9P
Spokane	+ 10P
West Virginia	
Charleston	— 26E
Wheeling	— 22E
Wisconsin	
Madison	+ 2C
Milwaukee	+ 8C
Wyoming	
Cheyene	+ 1M

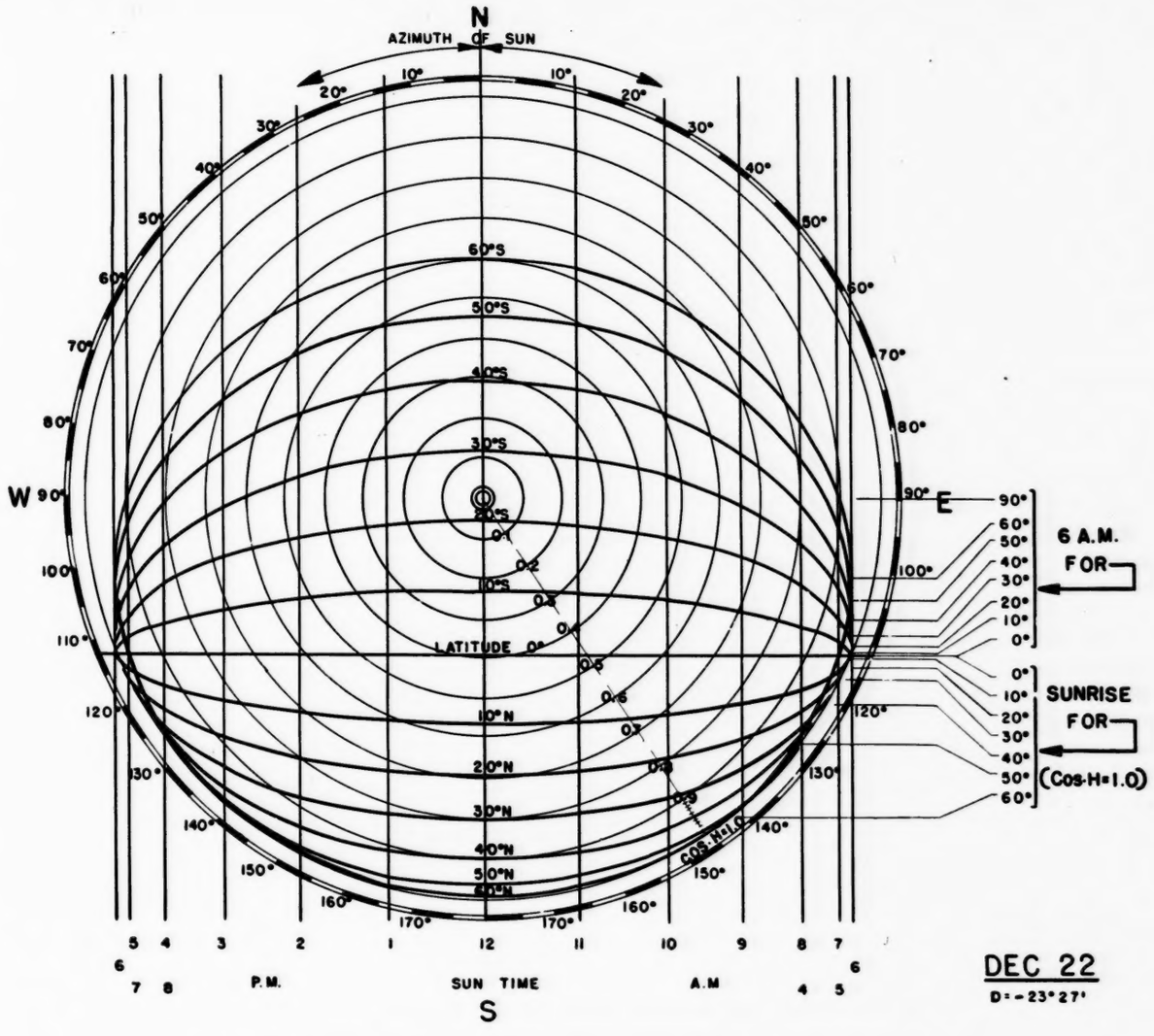


Fig. 9. Sun chart for December 22 when the sun's declination is —20° 27'.

and the point of intersection of the hour line and latitude line. This angle may be read directly in degrees. In the example the azimuth angle is 101° west of north or may be expressed as 11° south of west. With these two angles known an analysis of shading effects may be made.

Assume that it is desired to determine the incident angle—that is the angle the sun's rays make with a perpendicular to the wall—on a southwest wall in the same latitude and the same time of the year as above. Draw a line from the center of the circles to the 45° point, upper left, so that the line faces southwest, the direction the wall faces. Then draw a perpendicular to the line just constructed so that it passes through the intersection of the 4 p.m. and 40° north latitude intersection. By measuring with the dividers it will be found that the length of this line is 0.72 units, so that the incident angle is that angle whose cosine is 0.72, or 44°.

Standard and Sun Time

All the charts and tables in this article are based on sun time. Therefore, before the sun's position can be determined it is necessary to convert the local time to sun time.

First, it is necessary to determine the standard time, since in most localities war time or both war time and daylight saving time are in effect. If either war or daylight time is in effect, one hour should be subtracted to determine standard time. If both are in effect two hours should be subtracted.

It is then necessary to convert from standard to actual sun time. Before showing how this can be done it might be well to discuss briefly the standard time system

The United States is divided into four time zones each approximately 15° in width. These zones are called Eastern, Central, Mountain and Pacific. The zones are so set up that the 75, 90, 105 and 120th meridians, respectively, fall approximately in the center of the zones.

On these meridians standard time is the same as sun time. As the edges of the zones are approached the difference between the standard time and the sun time increases until at the boundary the difference reaches a maximum.

Table 3 was prepared to help determine the actual sun time. To use it, add to or subtract from the standard time for the locality under consideration the correction given in Table 3.

WASHINGTON NEWS

summarized by Loring F. Overman. L-38 Limits A.C. to "Essential" Uses; Kahler Heads New Construction Bureau; A.C. Section of WPB Adds Personnel.

The War Program has again entered a new phase.

Expansion of facilities has been the keynote to date. From now on maximum production of war goods through facilities now existing or nearing completion will be the watchword.

There are two reasons for this sudden shift of policy. *First*, actual production of war materials through new or converted industrial plants has progressed to a point approximating President Roosevelt's 1942 goal of 60,000 planes, 45,000 tanks and equally stupendous quantities of other war materials. *Second*, the surprising pace with which the goal has been attained has speeded by months the time when raw materials originally earmarked for facilities construction will be sorely needed for actual incorporation into weapons.

Effects on the heating, ventilating and air conditioning industry promise to be somewhat as follows:

1. Continuation throughout 1942 of industrial installations in plants already actually under construction;
2. Cancellation of many 1943 projects that have reached only the drawing board or authorization stage;
3. Expansion of military installations incidental to training of an enlarged army and numerous AEF's;
4. Continued peak volume for firms engaged in supplying Navy and Maritime Commission contracts for ship construction.
5. Continuance of the defense housing program and its many small unit installations; and
6. Conversion to bits-and-pieces assignments by firms unsuccessful in aligning themselves directly with the War effort.

The pattern for the new War Program became evident in Washington during May when War Production Board officials, while warning against undue optimism, announced that production—either actual or in sight—not only far exceeds expectations but is dwarfing the Nation's ability to make shipments to the battle fronts. Plans for plant expansion (except for synthetic rubber, explosives and aviation gas) are to be toned down in favor of greater production of munitions and shipping *now*.

L-38

Implementing the changed policy were the first of a probable series of new freeze orders—No. L-121 freezing for 90 days all stocks of softwood construction lumber except that needed for military use (the order was later revised to include defense housing) and L-38, banning new installations of air conditioning and commercial refrigerating equipment except to meet war and essential civilian requirements.

L-121 effectively puts a stop to any construction that cannot be directly identified with the war effort. By the same stroke of the WPB pen, L-121 also rules out much of the air conditioning equipment that might otherwise have been considered essential to the completion of an unfinished structure.

To make assurance doubly sure, however, L-38 writes a close definition of "essential" requirements; bans new installations designed solely for personal comfort, such as in theaters, restaurants, hotels, etc., and places rigid restrictions on the production and sale of air conditioning and commercial refrigeration equipment.

Until August 15, Order L-38 also permits only the Army, Navy and Maritime Commission to contract for production of such items as beer dispensers, carbonated beverage dispensers, bottled beverage coolers, low temperature mechanical refrigerators designed to store frozen food or to quick-freeze food, individual room coolers, florist boxes and display cases, and fountainette-type soda fountains. After that time, production of these items must be stopped completely.

Order L-38 prohibits the installation, effective immediately, of any new equipment except on "preferred orders." These orders apply only to the Army, Navy and Maritime Commission, certain other government agencies, Lend-Lease requirements, and persons possessing a preference rating of A-9 or higher issued directly to them and designating the type of equipment desired.

From May 15 to June 30, producers are prohibited from manufacturing any items of equipment in excess of the number of such items delivered on preferred orders from April 1 to May 15, or in excess of the number of such items for which unfilled preferred orders are now on hand. Producers may use the greater of the two quantities in determining their permissible production.

During any calendar quarter beginning with the quarter July 1-September 30, producers may not manufacture more items of equipment than the number for which they have preferred orders on hand, or the number delivered on preferred orders during the next preceding quarter, whichever is greater.

The order places no restrictions on sales, leases or deliveries of new equipment by a dealer to another dealer or to a producer, or by a producer to another producer or to a dealer, but both producers and dealers are prohibited from selling, leasing or delivering to any other person or from installing any new equipment except to fill a preferred order.

J. M. Fernald, Chief of WPB's Air Conditioning and Commercial Refrigeration Branch, pointed out that while the order results in a ban on new installations of non-essential equipment, it will not interfere with production or installations to cover health requirements, such as food processing and storage.

In considering applications for preference ratings under the order's terms, Mr. Fernald said, the branch will consider the following uses of equipment as essential:

1. Processing, transportation, storage, preservation, and distribution of food and food products only in those expanding defense communities where adequate minimum facilities do not exist in the opinion of the War Production Board;
2. Production, processing, transportation, storage, preservation, and distribution of milk and dairy products. (This does not include equipment for the manufacture, sale, or distribution of ice cream, frozen confections, carbonated or malt beverages);
3. Mining, manufacturing processes, communication equipment, and processing methods (including water and liquid cooling) where control of temperature or humidity can be proved necessary for production of the product or products;
4. Ice manufacture and storage only where, in the opinion of WPB, adequate facilities do not now exist; and
5. Miscellaneous applications in connection with testing and research laboratories; defense production drafting rooms which can demonstrate proof of actual need; operating rooms in regularly constituted hospital buildings; preservation of drugs, medicine and serums, mortuaries (body storage); and production inspection test rooms.

Mr. Fernald made it plain that

nothing in these five categories of essential uses could be interpreted as indicating that approval might be given to any application for new equipment designed for personal comfort.

To assist in the administration of L-38 and other matters pertaining to the industries affected, Branch Chief Fernald recently named the following section Chiefs:

A. H. Baer, chief, commercial and industrial refrigeration equipment section and acting chief, heat exchanger section;

Frank Riley, chief, refrigerator section;

M. C. Terry, acting chief, air conditioning section.

Mr. Baer was formerly vice-president of Frick Co., while Mr. Riley had his own business, Riley Engineering Corp., in Detroit. Mr. Terry is a refrigeration engineer from New Rochelle, N. Y.

The new branch, recently installed in quarters atop the Railroad Retirement building in Washington, now has a personnel of nearly a hundred and is rapidly completing the organization necessary to direct wartime activities of an industry comprising some 700 manufacturers who had factory sales of approximately $7,500,000 during the last quarter of 1941.

Construction Bureau Formed

As a further step toward coordinating the construction program designated as essential to the war effort, a Construction Bureau of WPB was formed during May.

William V. Kahler, on leave as chief engineer of the Chicago area, Illinois Bell Telephone Company, and since May, 1941, head of the construction branch, production division, is chief of the new bureau. In this capacity he will be a member of the plant site board.

A part of the production division, the bureau will:

George E. Hoffman, Consultant to the Plumbing and Heating Branch, answers a question at a Press Conference held by the Plumbing and Heating Branch of WPB May 19.

1. Service all construction essential to the war effort,
2. Recommend construction project priority ratings,
3. Apply the principles of conservation of essential materials to construction projects, and
4. Administer Conservation Order L-41 which places all private construction under rigid control.

Allocation Program Foreseen

Several activities within WPB point toward the early adoption of a materials allocation plan as a solution to the present struggle between priority ratings of varying potency, as issued by competing purchasing offices bent upon securing early deliveries. To date, military and government purchasing agents, with their PD-3A certificates, have possessed blank checks giving them first call on all equipment and supplies, regardless of whether or not their drafts left any balance on hand for other essential requirements.

The allocation plan will seek to view the supply situation as a whole and to determine a division of available supplies in a manner that will assure the most efficient utilization of visible inventories. Under the allocation plan, if military forces actually needed the entire available supply of a given metal, the allocationists might decide that best long-run results would be obtained by assigning the military 80% of the total; the remaining 20% to go to war-related industries whose continued operation would be more important to the military than the temporary denial of 20% of a needed total.

Priority ratings issued by military or government purchasing agents would then affect only the 80% allocated for their use, while the 20% allocated to other essential uses would be distributed with the aid of priority ratings granted by WPB through its industry branches.

"The time is approaching when outright allocations of raw materials must be made for rock bottom civilian needs," business paper editors were told at a meeting in Washington, May 19, by Phillip B. Hoppin, Chief, Priorities Section, Plumbing and Heating Branch, War Production Board. "These basic requirements, to keep the civilian population going, will then be placed on a par with direct military production.

"The PD-25A plan[1] can be effectively used in carrying out such an allocation program. If 10,000 tons of iron are allocated to a certain section of our industry, we would thereby be empowered to grant an effective rating to all the companies in that group so as to ensure deliveries. Our limitation orders can provide a limit on quantities to be used, and further, the control on PD-25A is so close that we will know just how much material is granted each quarter and how much we have left."

OFFICIALS OF WPB'S PLUMBING AND HEATING BRANCH

as they appeared at the Press Conference May 19. Left to right, standing, Ronald Allwork, Planning and Projects; Robert Housel, Operations Division; J. Brice Hungate, Pipes and Valves; H. M. Brundage, Appliances; David H. Butler, Heating; P. B. Hoppin, Priorities; John F. Steele, Liquefied Petroleum Gas Section. Seated, George E. Hoffman, Consultant; W. Walter Timmis, Chief of the Branch, and Lawrence Knappen, Assistant Chief.

PD-25A Important to Manufacturers

It is important for manufacturers of heating and air conditioning equipment to understand that after July 1, PD-25A, the Production Requirements Plan, will be the *only priorities in-*

[1]PD-25A plan is a Production Requirements Plan covering complete material requirements and overall operations of a manufacturer for a quarterly period.

strument covering manufacturers' material requirements.

Anticipating the date when use of PD-25A by manufacturers will become mandatory, the form has recently been greatly simplified, and permission has been granted to omit much of the information previously required.

In accordance with WPB's intent to establish the Production Requirements Plan as a single, overall priority instrument, most of the limited blanket ratings under which preference ratings have been assigned on an industry-wide basis will be revoked or allowed to expire on June 30. Thus, companies that have been using the blanket ratings will be *required* to apply under PRP.

L-79 Relaxed

WPB moved May 23 to relax the restrictions which were imposed upon the sale of plumbing and heating equipment in Limitation Order L-79 by removing the ban on equipment necessary for civilian needs.

One effect of the order as amended is to release the sale to householders of cooking and heating stoves and water heaters where no other heating for these purposes is available.

At the same time, the amended order facilitates the conversion of oil and gas burning equipment to the use of coal by permitting the sale and delivery of any equipment—such as grates—needed to convert such burners to the use of coal. It is expected that this provision will aid the conservation of the already limited supply of fuel oils in various parts of the country.

The original regulations forbade all sales of plumbing and heating equipment amounting to more than $5 per item on unrated orders, so as to give the Plumbing and Heating Branch an opportunity to study the needs for war production and essential civilian requirements. The revised order permits the shipment until June 30 of equipment for bona fide contractual orders which had been received no later than April 16, the date of issuance of the original L-79 regulations.

Another exemption from the previous provisions permits delivery of plumbing and heating equipment until July 31, 1942 for completion of projects started after July 31, 1941 and through April 9, 1942, if the purchaser certifies the necessity of such equipment. (April 9 was the date of issuance of L-41, the Construction Limitation Order.)

Hot water heaters, radiators, and other types of equipment which use electricity are excluded from the terms of the amended order. Thus, the ban contained in the original order on sale of many types of equipment connected to both water and electric systems is removed.

In addition to the above exemptions from the general prohibition on sale

William V. Kahler, Chief of the newly formed Construction Bureau of WPB.

or delivery of any metal plumbing or heating equipment to an ultimate consumer, the following provisions are included in the amended order.

Sale or delivery of any item costing no more than $5 is permitted, providing it is part of an order totalling no more than $10; Sale and delivery of any equipment on an A-10 or better preference rating is permitted; Sale and delivery of any equipment specifically designed for hospitals, or for surgical, dental, veterinary, barber shop, or beauty shop use is permitted; Any person may sell and deliver any equipment if the purchaser certifies that the equipment is needed to complete a project specifically authorized by the Director of Industry Operations in accordance with the Construction Limitation Order, L-41.

Sale and delivery of any cooking or heating stove or water heater is permitted if the purchaser certifies that such equipment is needed for use in his place of residence, and that there is not available to him any other equipment which could be used instead.

Any person may sell and deliver any equipment on the specific authorization of the Director of Industry Operations on the required form.

W. Walter Timmis, Chief of the Branch, said that "it rests with the industry to see to it that the amended order is made workable by a proper understanding of it, and by having all concerned operate within the spirit and the terms of the restrictions.

"In the sale of items which are not now directly controlled by the order, the industry should see to it that they are used only in accordance with the spirit of the order. Such items include pipe fittings, valves, and innumerable small plumbing and heating articles, which are generally obtainable, but are made of critical materials."

Mr. Timmis added that it would be the policy of the Branch to grant very few PD-1-A Preference Rating applications for civilian plumbing and heating requirements which may not be covered by the amended L-79 order. Most PD-1-A applications now in the hands of the Branch, if not automatically covered by the new order, will probably not be granted.

The restrictions of the amended order apply to the following types of heating equipment: (Any of the following items composed of at least 50 per cent metal) Steam and hot water heating boilers using oil or coal as fuel; cast iron heating radiators other than electric steam radiators, including (but not limited to) cast iron tubular radiators and cast iron convectors; hot water circulator pumps, vacuum pumps and condensation pumps; warm air furnaces which use coal or oil as fuel; heating stoves and space heaters which use coal, oil or gas as fuel, except gas-fired floor furnaces; oil burners; and metal fuel oil tanks.

L-123 Affects Fans

WPB assumed control May 26 over the distribution of many types of general industrial equipment so that they will be directed into war channels. The order, L-123, affects electric motors of more than 1 hp., industrial fans, industrial compressors and pumps, and a number of other classes of machinery used generally in various industrial operations. Some types of machinery within these classes are covered by other WPB orders and are therefore not restricted under L-123.

The order provides that no one may accept any order for or deliver any equipment listed in the 14 classes set forth except upon a preference rating of A-9 or higher or upon specific authorization of the Director of Industry Operations.

Manufacturers may ship machinery to distributors only to fill approved orders actually received by distributors or to replace machinery delivered by a distributor on an approved order.

Some Optimism Justified

While the Washington scene still has its kinks, there is evidence that a first phase of the war against the Axis has been won—the production goal is in sight in a war that is admittedly one of machines. There is cause for encouragement when a railroad system delivering only 2% of the East Coast's requirements a year ago can assimilate 50% in 12 months; promise to deliver 65% in a few weeks more.

There is cause for optimism in a program that finds business buckling down under gruelling restrictions; then producing at a rate that crowds the docks with undelivered goods. There is assurance, too, that even this shipping bottleneck will be eliminated, and that the Axis will, sooner than it anticipated, find that Americans are sufficiently sold on the American way of life to exert every effort to preserve it.

TANKS AND SPECIALTIES. Storage tanks for hot water heaters of the kind used in most homes are now manufactured in only three sizes as a result of a simplification schedule issued April 25 by WPB. This regulation will have no effect on the efficiency of the heaters, but the simplification will free 2,000 tons of brass and 1,000 tons of steel for the war effort. The Schedule (No. IX) to Limitation Order L-42 covers direct-fired gas storage water heaters. It eliminates all models requiring more than one flue, as well as restricting the manufacture of storage tanks to three sizes. Use of metal jackets, or of brass and copper in certain parts is also prohibited. Another Schedule (No. VIII) to the Limitation Order, requires the simplification of vacuum and vapor heating specialties after June 15. These include various types of traps, strainers, and valves. It is estimated by WPB's Plumbing and Heating Branch that this Schedule will save about 100 tons of stainless steel, and approximately 850 tons of copper and copper-base alloy.

FREON. Changed preference ratings for all permitted uses of chlorinated hydrocarbon solvents were announced May 2 by the Director of Industry Operations, with amendment of Order M-41. The order extends A-10 ratings for such solvents to be used for the manufacture of refrigerants.

PLUMBING. C. M. Wilcox, Washington, was appointed May 15 chief of a newly created plumbing section of the Plumbing and Heating Branch of WPB. The plumbing section will be responsible for plumbing fixtures, trim, fittings, and specialties. Mr. Wilcox recently had been on the staff of the standards section of OPA, for which he prepared standards on plumbing. Previously, he was a mechanical engineer in the War Department, where he designed specifications for Army construction.

PD-1A FORMS. A coding chart for air conditioning and refrigeration equipment has been prepared by William B. Henderson, executive vice president of ACRMA in informal collaboration with the Air Conditioning and Commercial Refrigeration Branch of WPB. The chart is an 8½ x 11 in. affair in three columns, the first listing the ultimate buyer or user of the equipment, such as Army Air Corps; Army Engineers; Retail Food Establishment, Repair and Maintenance, and so on, each being numbered. Numbers are also assigned to the 38 items in the second column which lists the manufacturing industry or business classification of the buyer, such as aircraft, machinery, textiles, restaurants, and so on. In the third column are 13 numbered items covering the application or functional use of the equipment, such as preserving foodstuffs in storage, conditioning manufacturing spaces, and so on. It is suggested that one of these charts be attached to each PD-1A Form going to the Air Conditioning and Refrigeration Branch of WPB and on which the person making the application checks one figure in each of the three columns. In this way PD-1A Forms will be cleared by the Branch much more quickly. The Form may be duplicated but should be sent to WPB only on an 8½ x 11 in. sheet. Copies are available from Mr. Henderson at the ACRMA offices in the Southern Building, Washington.

SUGGESTIONS. In this connection, if there are any questions as to how WPB should handle its end of the Coding Chart, please telephone or write Sterling Smith, Chief, Planning and Requirements Section, Air Conditioning and Commercial Refrigeration Branch of WPB, Washington. Telephone Republic 7500, Extension 5876.

POWER. Limitation Order L-94 on electric power was issued by WPB May 1 to prepare for possible power shortages in all areas. The order lists certain restricted uses of power which, the order implies, will probably be cut off from power when the occasion arises. Included among these restricted uses are refrigeration for air conditioning, except where essential for industrial processes.

CONDENSING UNITS. The formation of an industry advisory committee for refrigeration condensing units was announced today by WPB May 11. The committee will consist of Sterling F. Smith, section chief, Air Conditioning and Commercial Refrigeration Branch, Government Presiding Officer; members are: W. C. Allen, Lynch Mfg. Corp., Defiance; W. W. Higham, Universal Cooler Co., Marion, Ohio; Frank H. Faust, General Electric Co., Bloomfield, N. J.; Byron E. James, York Ice Machinery Co., York, Pa.; Charles Knox, Baker Ice Machine Co., Omaha; B. J. Scholl, Brunner Manufacturing Co., Utica; H. C. Morrison, Curtis Refrigerating Machine Co., St. Louis; and Lars Hanson, Carrier Corporation, Syracuse.

WAR HOUSING. Contracts for 21,946 war housing units were awarded during the month of April, Commissioner Herbert Emmerich of the Federal Public Housing Authority announced May 12. This total includes 17,656 family units, dormitory space for 3,640 persons and 650 trailers.

More than one thousand war housing projects financed and supervised by Uncle Sam have now been built or are under way in the Government's program for housing men and women war workers.

Figures released by the Federal Public Housing Authority showed 1,011 war housing projects containing 367,522 homes. This is in addition to the large number of homes being developed for war workers by private builders.

The next day, May 13, Commissioner Emmerich told the National Association of Housing officials the public war housing program must be stepped up to provide five times as many homes in a third the time as in any previous public housing effort. This unprecedented schedule of construction is necessary, he said, to provide shelter and decent living conditions for the great army of migrating workers demanded by the war industries. These workers must be provided adequate housing if our army and navy and air forces are to be sustained and are to prevail.

TANKS. Manufacturers using sheet metal materials of a size requiring extra lengthwise seams in making domestic fuel oil storage tanks are granted an allowance to compensate them for the increased production costs by Amendment No. 1 to Revised Price Schedule No. 96 (Domestic Fuel Oil Storage Tanks) announced May 21 by Price Administrator Leon Henderson. The allowance is similar to one in effect for manufacturers who use materials requiring extra transverse seams. This action, which became effective May 25, allows manufacturers to add 75 cents for each pair of extra lengthwise seams to the maximum prices established in the schedule.

NO COMFORT A.C. The Federal Works Agency on May 25 listed nearly 200 specific items which it has eliminated, so far as practicable, in the construction of war public works projects, in line with further restrictions on the use of critical materials announced a few days before. FWA will not approve the construction of air conditioning systems for human comfort.

DORMITORIES. "Duration dormitories," temporary in structure but providing the accommodations essential to the health and welfare of war workers, are now being developed by the Federal Public Housing Authority as part of its war housing program. Each dormitory is composed of from two to four sleeping wings, with a sanitary center with lavatories and showers. In the basement of the sanitary unit will be located the central heating systems for the dormitory.

HOUSING. On May 27 President Roosevelt asked Congress to increase the authorization for public defense housing construction by $600,000,000 but specified that most of the low-cost dwellings would be "temporary in nature" so as to conserve critical materials. The President, on May 26, signed a measure increasing from $300,000,000 to $800,000,000 the amount of private loans for defense housing which FHA may guarantee.

ABSTRACTS of Current Papers, Books and Pamphlets

Fundamentals of Heat Transfer

The subject of heat transfer has developed along three distinct lines: first, through studies of the ways in which heat is transmitted; second, by the formulation of mathematical expressions based upon the various factors that have been found to influence the rate of transfer; and third, by the accumulation of experimentally determined coefficients and constants for substitution into these mathematical expressions. The authors point out that much has been done in the way of compiling and publishing detailed information covering the final phase but not so much in regard to the first two. Accordingly, in this book they place emphasis on acquiring a clear conception of the manner in which heat is transmitted and upon the development of the mathematical formulas applying to heat transfer through clean surfaces.

No extensive claims as to originality for the text are made except in the method of presentation of the material. The purpose is to present the fundamentals of heat transfer in the manner that is readily comprehensible and at the same time fairly comprehensive.

Among the more interesting chapter headings are the following: Equations for the Calculation of Heat Transfer by Conduction (Steady State); Heat Transfer to Boiling Liquids; Condensing Vapors; Over-All Transfer of Heat; Application of the Principles of Heat Transfer to Design Problems, and Variable Heat Flow.

[*"Introduction to Heat Transfer," by Aubrey I. Brown and Salvatore M. Marco. Published by McGraw-Hill Book Company, Inc., 330 West 42nd St., New York, N. Y. Cloth bound; 232 pages; 6 x 9 in. Price, $2.50.*]

•

Plant Design

In this book the author, who is head of the department of chemical Engineering at Virginia Polytechnic Institute, has as his purpose the dealing with only one of the two main phases of chemical engineering design, namely, plant design rather than the design of equipment. The subject has been developed with particular reference to advanced students in chemical engineering, to recent graduates of such courses, and to seasoned professional chemical engineers. However, the viewpoint of the plant executive in chemical engineering industries who is not technically trained in chemical engineering, also has been kept in mind. The book treats extensively and thoroughly of practically every phase of design involved in typical chemical manufacturing plants; and the phases covered include everything from preliminary layout to operating problems of the completed plants. A great deal of consideration is given to the physical structure of buildings, and in the chapter devoted to this subject ten pages are given over to heating and ventilating requirements. Other chapters which contain particularly valuable information are Plant Location; Flow Diagrams; Selection of Equipment; Cost Accounting; and Plant Layout and Elevation. The chapter on Cost Accounting, with its charts and breakdown tables giving performance and cost data on the installation, operation and maintenance of plant machinery, is especially worthwhile. In the appendix are found a number of useful tables, together with several sample problems of plant design which are carried through step-by-step to solution. These should serve as a valuable guide to those engaged in plant design.

[*"Chemical Engineering Plant Design," by Frank C. Vilbrandt, Ph.D. Second edition. Published by McGraw-Hill Book Company, Inc., 330 West 42nd St., New York, N. Y. Cloth bound; 6 x 9 in.; 452 pages. Price, $5.*]

•

Oil Burner Handbook

A little over a year ago the original edition of this handbook appeared, and the need for a service manual and general information book such as this was immediately evidenced by its favorable reception. As a result the author was encouraged to enlarge and revise his first edition, and in this second edition he has included industrial oil burners as well as added a section for the particular guidance of the small heating plant superintendent or home owner.

This book is especially valuable at the present time because of the need for conservation of fuel as well as of materials and parts entering into the upkeep of oil burning equipment. The author uses a direct simple style, easily understood by the average oil burner owner having only a superficial knowledge of oil burners, and is equally useful to the service man as a field reference manual.

Discussed in detail are domestic and industrial oil burners; fuel oil; combustion; boilers; oil burners; storage tanks; servicing; installations; use of tools; electricity; and controls.

[*"An Oil Burner Handbook," by L. J. Whelan. Published by The Master Plumber & Heating Contractor Magazine, 554 Atlantic Avenue, Brooklyn, N. Y. Cloth bound; 245 pages; 7½ x 5 in. Price, $2.50.*]

•

BRIEF REVIEWS

OIL BURNERS. A commercial standard, effective for new production from January 1, 1943, for flue connected oil burning space heaters equipped with vaporizing pot type burners. [*"Flue Connected Oil Burning Space Heaters, CS101-43." Published by the U. S. Department of Commerce, National Bureau of Standards, Washington, D. C. Mimeographed; 8 x 10½ in.; 22 pages. Printed copies, when available, will be mailed on specific request from the U. S. Department of Commerce.*]

PRIORITIES. The problem of handling priorities has, in a good many cases, become such an involved one requiring expert analysis as well as a great amount of paper work, long distance calls, and the like, that some organizations have taken it upon themselves to simplify the situation in their own fields, at least, by issuing specialized digests for the guidance of those directly interested. One of these that has come to our attention recently is a booklet prepared for heating contractors describing and interpreting the War Production Board's priority preference orders and limitation orders which apply to that field.

Another booklet having the same general purpose covers the same field of priorities as related to the manufacture and marketing of pressure gages, safety valves, industrial thermometers, and globe valves, and was designed for the express purpose of acting as a guide to the company's jobbers, salesmen, and customers. [*"Priorities Mobilize Production for Victory." Published by Manning, Maxwell & Moore, Inc., Bridgeport, Conn. Paper cover; 6 x 9 in.; 16 pages. Obtainable from Manning, Maxwell & Moore, Inc., upon request. "Simplification of the War Production Board's Priority Preference Orders and Limitation Orders. Digest Prepared for Heating Contractors." Published by The National Radiator Company, Johnstown, Pa. Paper cover; 9 x 12 in.; 31 looseleaf pages. Obtainable from The National Radiator Company upon request.*]

SALESMEN AND THE WAR. The effect that the war is having on salesmen and their activities has been made a subject of study by this advertising company and the results set forth in a symposium based on information obtained from sales executives representing a cross-section of business and industry. Since most of the companies interviewed were almost 100% engaged in war orders, with their entire outputs sold for the duration, it might be assumed that there would be little use for salesmen in their organizations at this time. Interestingly enough, however, it was found that less than 10% of these companies have let all or even a large part of their salesmen go. More than 50% of the companies are still having their salesmen call on customers, although the number of calls has, in most cases, been reduced. This booklet gives other interesting figures showing how salesmen have been worked into other duties and how their potentialities are, in many cases, being drawn on to good advantage. [*"Utilizing Salesmen in Wartime." Published by G. M. Basford Company, 60 East 42nd Street, New York, N. Y. Paper cover; 6 x 8½ in.; 12 pages. Available from the G. M. Basford Company.*]

MINE VENTILATION. An information circular by the Bureau of Mines listing a new set of tentative coal-mine inspection standards intended to serve as a guide for the Federal inspection of coal mines in the United States. Circular has two general divisions dealing respectively with underground and surface hazards in connection with mine operations. Six pages are devoted to a detailed discussion of mine ventilation. [*"Tentative Coal-Mine Inspection Standards—Information Circular I.C. 7204." Published by the Bureau of Mines, U. S. Department of the Interior, Washington, D. C. Paper cover; mimeographed; 8 x 10½ in.; 48 pages. Available from the Bureau of Mines.*]

VENTILATION. Two papers presented at the Industrial Safety Conference at the Virginia Polytechnic Institute will interest ventilating engineers. The first of these, called "Dust Hazards in Industry", deals mainly with the two principal types of dusts which the ventilating engineer has to contend with in industry—the fibrosis-producing, such as silica and asbestos, and the toxic, of which lead and zinc are examples. The author gives detailed methods for detecting and sampling these dusts together with the best known method of combating them, of which ventilation is one of the most important. The second paper, dealing with protection against industrial toxic gases and vapors, gives a brief outline of the most commonly found vapors and gases in industry and outlines adequate protection methods which can be used against them. The author distinguishes between fumes, gases and vapors, and further breaks down his subject into asphyxiants, irritants, volatile drugs and anesthetics, and inorganic and organometallic substances. Examples of each have been studied and their properties, as well as their effects on workers in industry, are explained in detail. Ventilation, again, is listed by the author as of primary importance in dealing with these gases and vapors. Six other papers of interest to safety engineers were presented at the meeting and are included in the bulletin. [*"Bulletin of the Virginia Polytechnic Institute—Proceedings of Industrial Safety Conference, November 8, 1940," Engineering Extension Division Series No. 38 — Vol. XXXIV, No. 4, January, 1941. 6 x 9 in.; paper cover; 53 pages. Published by Virginia Polytechnic Institute, Blacksburg, Va.*]

WELDING HAZARDS. Bulletin providing practical information on the hazards arising out of electric and oxy-acetylene welding. Gives information on eye injuries; burns; gases, fumes, and smoke; metal fume fever; metal poisonings; control of gases and fumes; use of respirators; oxyacetylene welding and cutting; and summary. Of particular interest to heating and ventilating engineers is the information on exhaust ventilation for the control of gases and fumes given off during the welding processes. [*"Control of Welding Hazards in Defense Industries." Special Bulletin No. 5. Published by the U. S. Department of Labor, Division of Labor Standards. Paper cover; 6 x 9 in.; 15 pages. For sale by the Superintendent of Documents, Washington, D. C. Price, 10 cents.*]

OIL BURNERS. Commercial standards for automatic mechanical draft oil burners designed for domestic installations. The purpose of this commercial standard is to establish minimum standard specifications and methods of test for the guidance of manufacturers, distributors, installing contractors, and users. Covers general requirements, manufacturing and production tests, laboratory requirements and test procedure, installation requirements and performance tests and oil burner certificate to be placed with each oil burner installation. [*"Automatic Mechanical Draft Oil Burners Designed for Domestic Installations", Second Edition. Commercial Standard CS75-42, published by the National Bureau of Standards, U. S. Department of Commerce, Washington, D. C. Mimeographed, 8½ x 11 in. 20 pages. Available from the Bureau of Standards.*]

MINE VENTILATION. A critical analysis in book form of the factors underlying gas and dust explosions in coal mines, with the end in view of eliminating all such disasters wherever possible. With a background of twenty-five years of actual mine experience, the author, who has reviewed technical reports of safety experts in Federal and State agencies, supplementing these with conclusions of committees of investigations of the United Mine Workers, has given their interpretation great practical significance. The bulletin deals specifically with the six outstanding mine disasters of 1940, all of which resulted from explosions of either gas or coal dust. The author makes the point that this type of mine disaster can be entirely eliminated if due consideration is given to the air conditioning and ventilating of all mines. The inter-relation of modern machine methods and dust hazards in mines, and the use of explosives and blasting, are treated extensively by the author. A suggested program for mine safety is also discussed in the closing chapters. [*"Preventing Fatal Explosions in Coal Mines," by E. A. Wieck. Published by the Russell Sage Foundation, 130 East 22nd Street, New York. Paper cover; 6 x 9 in.; 156 pages. Price, 75 cents.*]

ELEMENTARY SCHOOLS. A non-technical bulletin of use to architects and engineers who are interested in the design and construction of elementary schools. Bulletin uses a new method of approach for the design of buildings of this type and the author attempts to correlate sound construction, planning and proper use of materials with new teaching techniques and problems of transportation, zoning, and recreation. Of interest to heating and ventilating engineers are the sections on natural environment which give information on the climatic conditions in Texas, light, amount of air to be supplied, and types of heating systems to use. [*"Space for Teaching — an approach to the design of elementary schools for Texas," by William Wayne Caudill. Published by the Texas Engineering Experiment Station, College Station, Texas. Paper cover; 120 pages; 8½ x 11 in. Available on request from the Texas Engineering Experiment Station.*]

HEAT TRANSFER. A report of an investigation undertaken for the purpose of obtaining information essential for the design of equipment for heating finely divided materials falling through a gas. Gives results of tests of a flash calciner for the decomposition of hydrated zinc sulphite and also the theoretical treatment essential to the complete development of such a problem. [*"Heat Transfer to Clouds of Falling Particles," by H. Fraser Johnstone, Robert L. Pigford, and John H. Chapin. Bulletin No. 43. Published by the University of Illinois, Engineering Experiment Station, Urbana, Illinois. Paper cover; 6 x 9 in.; 58 pages. Price, 65 cents.*]

COLLOIDAL CHEMISTRY. A textbook on industrial chemistry of colloidal and amorphous materials, a subject which is of marked interest at the present time due to the many chemical problems in which wartime industry is involved. The book attempts to give readers, starting a study of the subject with a general background of chemistry, a satisfactory introduction to the field; and for this reason the first part of the book is devoted to the presentation of certain basic material lacked by the average reader. The work is the outgrowth of 30 years of personal, practical experience both in teaching and in industry. The authors deal comprehensively and thoroughly with various phases of industrial and physical chemistry, including such subjects as Structure of Liquids; Adsorption; Suspensoids; Thermoplastics, Rubber, Textile Fibers, Ceramic Industries, and others. [*"Industrial Chemistry of Colloidal and Amorphous Materials," by Warren K. Lewis, Lombard Squires and Geoffrey Broughton. Published by The Macmillan Company, 50 Fifth Ave., New York. 540 pages; cloth bound; 6 x 9 in. Price, $5.50.*]

INSULATION SPECIFICATIONS. An eight-page engineering data booklet giving the specifications and recommendations applicable to the use of mineral wool in low temperature work. General specifications, specifications covering auxiliary materials such as lumber, steel, asphalt and cement, as well as application standards, are listed. [*"Specifications for Mineral Wool in Low Temperature Installations"—Specification No. 1, December 16, 1941. 8½ x 11 in.; eight pages; paper cover. Published by Industrial Mineral Wool Institute, 441 Lexington Ave., New York, N. Y. Single copies available free upon application to the Institute.*]

AIR ANALYSIS. Describes a method of determining nitric oxide, carbon disulfide, and hydrogen sulfide content in air. Apparatus estimates very small amounts of these gases in mixtures of air and automatically reports these gas concentrations. Instrument was developed by United Gas Improvement Company and the Rubicon Company. [*"An Apparatus for Continuously Measuring and Recording H_2S and/or CS_2 in Atmosphere." Safe Practice Bulletin No. 29. Published by the Commonwealth of Pennsylvania, Department of Labor and Industry, Harrisburg, Pa. Paper cover; 8 x 10½ in.; 6 pages. Available upon request to the Commonwealth of Pennsylvania.*]

OIL HEATERS. Recommended commercial standard for flue connected oil burning space heaters with vaporizing pot type burners. This is being circulated to the industry for written acceptance. [*"Recommended Commercial Standard TS-3191 for Flue Connected Oil Burning Space Heaters Equipped With Vaporizing Pot Type Burners." Published by the National Bureau of Standards, U. S. Department of Commerce, Washington, D. C. Mimeographed; 8½ x 11 in., 22 pages. Available on request from the National Bureau of Standards.*]

MINERALS YEARBOOK. 1941 edition of the Bureau of Mines Minerals Yearbook which gives information on all minerals and mineral products as a complete official record of the mineral industry. Information includes data on production, stocks, distribution, trade and consumption of metals, non-metals, fuels, and mineral products. [*"Bureau of Mines Minerals Yearbook, 1941 edition." Published by the Bureau of Mines, Washington, D. C. 1459 pages; price, $2. Available from the Superintendent of Documents.*]

STANDARDS. A list of nearly 500 American Standards which are now available. [*"American Standards for 1942." Published by the American Standards Association, 29 West 39th St., New York, N. Y.*]

NEWS OF THE MONTH

Advantages of Industrial Air Conditioning Stressed in Talk by Partington Before Boston Air Conditioning Bureau

BOSTON—James Partington, Jr., air conditioning engineer with the General Electric Company, was the guest speaker at the May meeting of the Air Conditioning Bureau. As supervising engineer of his company's air conditioning in its numerous plants throughout the country, he directed the installation at the Everett, Mass., blackout plant, manufacturing superchargers for airplanes, special low temperature rooms ranging down to — 75C, several gauge rooms and numerous process applications.

In speaking of windowless blackout plants, Partington said:

"Under the impetus of blackout regulations, the windowless factory is becoming quite common, and these buildings are enjoying an opportunity of proving their economic merit. All connections with the outside, air intakes and exhausts, must be provided with vestibules, and a duplicate source of power, emergency lighting, and cooling water must be provided. A multiple unit air conditioning system is a basic requirement to minimize the effect of normal service difficulties.

"Of secondary importance are the desirable features of designing the system so it will be flexible enough to accommodate substantial relocation of load centers due to changes in the manufacturing process, and so it will have some additional capacity to handle increased production quotas or an entirely different type of manufacture in the future. The first feature can usually be accomplished by a slight increase in duct sizes and the second by providing sufficient floor space for additional condensing unit capacity.

"A later development in blackout buildings has been the substitution of transite or similar materials for window panes. Light is kept in and the hazard of breaking glass eliminated. The air conditioning load is also reduced due to a saving in sun effect.

"In the new buildings, located away from the coast with their crowded and costly industrial areas, floor space is measured in acres instead of square feet and natural lighting and ventilation become entirely inadequate in their usefulness. Thus a ventilation system is required properly to provide fresh air. Filters are needed to eliminate pollen and dust instead of the city dirt. The added heat of an adequate artificial lighting system would place another burden on the ventilation system. On top of these new heat loads, we must consider the complete mechanization of machine tools brought about by the race for production and the scarcity of trained labor. It is not uncommon for motors alone to add a ton to the load for each 20 x 20 ft. block of floor area, or what we used to figure for the entire load in a similarly sized office.

As finished parts must be absolutely interchangeable, tolerances have to be reduced to a minimum and temperature variation, the foe of close tolerances becomes a new enemy. Temperature control being imperative, it becomes but a short step to complete year round air conditioning. Constant temperature is a must in the standards rooms, where gauges and measuring devices are calibrated, while controlled de-humidification to prevent rust is quite often of prime necessity. Uniform air distribution at relatively low velocities is required because delicate instruments live up to their name. Even ponderous vertical boring mills can be warped out of alignment by being in a draft.

"Powder magazines require air conditioning to maintain constant temperature so the powder does not lose its full effectiveness. Controlled temperatures have favored the manufacture of fractional horsepower motors by eliminating the effects of static electricity and by almost entirely removing breakage of the cotton insulation as it is spun onto the wire. Munitions manufacturers use refrigeration as part of a unit for shock testing shell points of various caliber shells. The points are heated to 212F in a vat of water and then quickly quenched in a second container of cold water.

"Increased use of aluminum in aviation has added to the demand for refrigeration to cool anodizing tanks. Anodizing, an electrolytic process, requires a vast amount of current, which produces large quantities of localized heat. The sulphuric acid solution used in the tanks must be maintained within plus or minus two degrees of an ideal temperature. A 15 hp condensing unit is required to handle a tank 3 x 8 x 5 ft. An acid-resistant pump circulates the sulphuric solution through a lead-lined interchanger which has cold water from a chiller circulated through its tubes. Because of the large heat removal from such a small volume, it was found that immersing lead pipe coils around the sides of the tank would be inadequate.

"A new field has been opened up for heat exchangers by the demands of war. By adding a transformer cooler, your already overloaded units may be able to handle your increased electrical consumption. The oil in the transformer is circulated through a finned surface over which propeller fans blast a stream of air, removing the heat and possibly increasing capacity of the transformer by 50%.

For so many employees who have had the chance to work under good weather conditions in industry, air conditioning in the future, after the war, will become a vital, integral part of their daily lives. The plant without air conditioning will become the marginal producer and not be long able to survive. The air conditioned plant will have the pick of the labor market and be able to turn out a better product at a lower unit cost.

ASHVE St. Paul Meeting

ST. PAUL—Arrangements have been completed, the technical program laid out, and committees of the local chapter are ready for the 1942 semi-annual meeting of the American Society of Heating and Ventilating Engineers, to be held here June 15-17. A feature of the meeting will be an address by W. W. Timmis, chief of the Plumbing and Heating Branch, War Production Board, who will address the convention at a get-together luncheon at noon, June 15.

The program of the technical sessions follows:

JUNE 15—1:30 P.M.

Performance of a Forced Warm Air Heating System as Affected by Changes in the Volume and Temperature of the Air Recirculated, by A. P. Kratz and S. Konzo.

Analysis of the Problems Encountered in Intermittent Heating of Buildings, by E. K. Campbell.

Performance Characteristics in Panel Heating, by B. F. Raber and F. W. Hutchinson.

JUNE 16—9:30 A.M.

Air Conditioning of Blackout Plants, by W. A. Grant.

Physiological Reactions, by A. R. Behnke, Lt. Comdr., U. S. N. (MC)

JUNE 17—9:30 A.M.

Comparative Study of Heat Loss in Insulated and Uninsulated Houses, by D. B. Anderson.

The Specific Heat of Thermal Insulating Materials, by Gordon B. Wilkes and C. O. Wood.

The Overloading of Air Filters During Accelerated Tests, by Frank B. Rowley and Richard C. Jordan.

Wilson Elected ACRMA President

WASHINGTON—Charles E. Wilson, vice-president of the Worthington Pump and Machinery Corp., was elected president of the Air Conditioning and Refrigerating Machinery Association, Inc., at its annual meeting held in New York City May 8.

Other officers are J. P. Rainbault, General Electric Company, first vice-president; W. H. Aubrey, Frick Company, Incorporated, second vice-president; and P. A. McKittrick, Parks-Cramer Company, treasurer.

William B. Henderson continues as executive vice-president.

Demand for Refrigeration to Hit Peak, ODT Section Points Out, If U.S. Is to Become Food Arsenal for United Nations

WASHINGTON—If America is to become the food arsenal of the United Nations, immediate steps must be taken to insure adequate refrigeration space to store the food supplies of coming seasons, the Office of Defense Transportation points out.

An all-time high demand for refrigerated storage space is expected next autumn as a result of increased production of perishable foods to meet military, civilian, and lend-lease requirements.

Reports to the Refrigerated Warehousing Section of the ODT's Division of Storage show that occupancy of refrigerated warehouses in some sections of the country is substantially higher this spring than in previous years. Shortages of refrigerated warehouse space may develop as the production season advances, unless additional space is made available. A program to forestall future shortages has been undertaken by the Division of Storage.

Refrigerated warehousing is of two general types. Cooler space (30F) is used for the storage of fresh fruits and vegetables, eggs, cheese, lard, and certain packinghouse products. Freezer space (0F) is used for the storage of frozen fruits and vegetables, fresh meats, fish, poultry, frozen eggs, and butter.

In recent years the trend has been toward increasing use of freezer space, with a corresponding reduction in the relative importance of cooler space. Wartime conditions are accentuating this trend. Heavy increases in 1942 production quotas of pork and other meat products, poultry, dairy products, eggs, and other perishable foods will make it necessary to provide large amounts of freezer space. At the same time, the shortage of tin containers is expected to result in a marked increase in the production of frozen foods, which require freezer space for storage.

To meet expected demands for storage space, and to provide for unpredictable contingencies, with a minimum expenditure of materials and equipment, ODT officials have recommended to the refrigerated warehousing industry that about 11,500,000 cu ft of space in cooler warehouses be converted to freezer space in areas where production, processing, and market demands indicate additional facilities are needed. A conversion program of this magnitude would increase the total amount of freezer space in public refrigerated warehouses by about 10%. At present, total cooler space in public warehouses amounts to about 259,000,000 cu ft and total freezer space to about 113,800,000 cu ft.

Conversion of cooler to freezer space involves little new construction and is relatively inexpensive. In most cases, conversion can be effected by adding insulation and pipe coils to existing cooler facilities. Additional refrigerating machinery is necessary in some cases.

Conversion of between 2,000,000 and 3,000,000 cu ft of cooler space to freezer space is already under way. Since the conversion process takes from three to six months, ODT officials point out that speedy action by operators of refrigerated warehouse facilities is necessary in order to make available an additional 8,500,000 to 9,500,000 cu ft of converted freezer space in advance of the season of peak demand which begins in August.

N.Y. Testing Lab Is Taken Over

NEW YORK—Electrical Testing Laboratories, Inc., announced it has acquired the plant and equipment and taken over the staff of Electrical Testing Laboratories and is offering its services to government and industry for testing work.

Located at 2 East End Ave., at 79th St., New York, the laboratory is equipped to carry on independent and impartial general testing, inspection, analysis, research and certification on electrical, optical, physical, mechanical and chemical operations. It is now employee owned with the following officers: President, Preston S. Millar; vice-president and chief engineer, F. Malcolm Farmer; vice-president and treasurer, Denis J. Lees; assistant treasurer, Gordon Thompson; and secretary, Caroline E. Slocum.

Bullock Heads L.A. Group

LOS ANGELES—Lawrence Reuland of the B. F. Goodrich Co. delivered a talk on experiments being conducted toward developing substitute materials to replace natural rubber in American industry at the monthly meeting of Southern California chapter, ASHVE, held April 6.

The following were elected to chapter offices for the 1942-43 term: Howard Bullock, president; Wesley O. Stewart, vice-president; Leo Hungerford, secretary; and Marin Kennedy, treasurer.

Steel Boiler Sales Increase

WASHINGTON — Steel heating boilers having a total of 261,669 sq ft of heating surface were shipped in March as compared with 211,819 sq ft in March, 1941, and 113,996 sq ft in March, 1940, according to the Bureau of the Census, U. S. Department of Commerce.

Burner Men Discuss Service Charges

BOSTON—Members of the Massachusetts Oil Heating Association and other oil burner and burner servicing concerns in this area are having their troubles in connection with the price freezing recently decreed by OPA, but instead of sitting down and moaning about it, they propose to do something. Following an open forum meeting of the association May 12, it was voted to appoint a committee to analyze service charges and draw up specifications for an increase in these that will meet with approval of OPA.

Analysis of a large number of questionnaires sent out covering a long list of items, prepared and read by Secretary Fred Beckwith at the meeting, shows that service charges range from $1.25 for the first hour and approximately the same rate for subsequent hours or fractions, to $3.90 per hour. But, while 30% of the firms charge $3 per hour and 33% charge $3.50, only 2% of those answering charge as much as $3.90.

Wages range from $30 to $65 per week, with the average running between $40 and $45. Wage costs, added to various taxes, overhead and transportation costs, plus time en route to jobs, brought, according to Secretary Beckwith's analysis, the cost of a service call to a minimum of $3.41 per hour.

This figure does not allow for idle shop time, which is unproductive in most cases, and, according to the Beckwith figures, would total about one-third of the wage paid time in the course of 52 weeks.

The committee to confer with OPA authorities, either the regional director (although final decision would come from Washington), or with that branch of OPA in Washington, will endeavor to have the board lift the ceiling on service charges, or at least modify it, so that firms will not be doing this type of work at a loss.

Heating Ordnance Explained

LOS ANGELES—The Southern California Gas Co. on May 6 instituted a series of classes for review of heating installation problems to enable heating contractors and journeymen heating plant installers to familiarize themselves with the requirements of the new Los Angeles ordinance requiring a qualifying examination before a certificate of registration can be issued.

The classes are being held from 7 to 9 p.m. Wednesdays in the company's auditorium, Seventh and Channing Sts., and are free to contractors as well as heating installers employed by contracting firms.

Warm Air Association to Meet

CLEVELAND — The Victory with Warmth semi-annual convention and conference of the National Warm Air Heating and Air Conditioning Association will be held at the Stevens Hotel, Chicago, June 9.

At the morning session H. S. Sharp, president of the Association and vice-president of Henry Furnace & Foundry Co., will address the convention followed by P. B. Zimmerman, chairman of the Association's Publicity and Merchandising Committee and vice-president of the Airtemp Division of Chrysler Corporation, who will speak on Tomorrow—Not Today. W. L. McGrath, general manager of the Williamson Heater Company and member of the Plumbing and Heating Industry Advisory Committee, WPB, will present his impressions of the industry as he sees it today. Other speakers at the morning session include F. G. Sedgwick, chairman of the Research Advisory Committee; W. D. Redrup, chairman of the Installation Codes Committee; and Professor S. Konzo. A representative of WPB will lead a discussion on Priority Ratings and Limitation Orders which will be followed by a question and answer period. During luncheon Cy T. Burg, general sales manager, Iron Fireman Mfg. Co., will talk on The Golden Touch.

In the afternoon a session will be held for manufacturers covering conversion to war work. The session will be under the chairmanship of H. P. Mueller, first vice-president of the Association and president of L. J. Mueller Furnace Co. The speakers will include T. I. Byrd, American Rolling Mill Company; Tom Johnson, metallurgist of the Republic Steel Corporation; and a representative of the Carnegie-Illinois Steel Corporation.

Gov't Building New Heating Plant

WASHINGTON — The Capital's multiplying thousands of new war workers will find little comfort — during the coming heating season, at any rate—in the fact that construction is proceeding at a rapid pace on a new West Central heating plant. Construction of the plant, to cost $4,000,000, was authorized last year, and the groundwork is under way. The plant will not be completed in 1942.

In the meantime temporary buildings spring up overnight along the Mall, as well as in other parts of the city, with the result that the heating capacity of the present central heating system is said to be taxed beyond requirements. Washington's mild winter and early spring solved the problem temporarily, but plans for next winter include lowering of temperatures to 65F in an effort to spread the service equitably.

All-Industry Conference Held by Refrigeration Groups

CHICAGO — John Wyllie, Jr., vice-president, Temprite Products Co., was elected president of the Refrigeration Equipment Manufacturers Association at the All-Industry Meeting and Conference Clinic of the Air Conditioning and Refrigeration Industry held here May 10-13 at the Stevens Hotel. R. H. Luscombe, sales manager, Penn Electric Switch Co., was elected vice-president and A. B. Schellenberg, president, Alco Valve Co., was elected secretary. Mr. Wyllie succeeds E. A. Vallee, Automatic Products Co., who served two years as president of Rema.

In addition to the meeting of Rema, the National Refrigeration Supply Jobbers Association held its annual convention as part of the All-Industry Conference, as did the Refrigeration Service Engineers Society.

Alex Holcombe, Jr., Victor Sales & Supply Co., Philadelphia, was elected president of the Jobbers group for the coming year.

Practically all of the talks and papers presented at the Conference dealt with some phase of the industry's part in the war program. Among the speakers were Harry C. Williams, assistant chief, Air Conditioning and Commercial Refrigeration Branch, WPB; Dr. William R. Hainsworth, vice-president, Servel, Inc.; Henry A. Dinegar, chief, Consumers Durable Goods Section of the Division of Civilian Supply, WPB; Mr. Schellenberg, and others.

Huge Post-War Housing Plan Proposed by Straus

NEW YORK—A gigantic wost-war public housing program, to replace 4,500,000 "tenements, hovels and rural shacks" throughout the nation over a fifteen-year period, was advocated May 21 by Nathan Straus, former USHA Administrator, in a talk before a dinner of the United Tenants Leagues of Greater New York.

"A simple but effective amendment of the United States Housing Act," Mr. Straus said, "would, in the opinion of qualified experts in banking, make it possible for all public housing to be financed by the sale of local housing authority bonds to banks and institutional and private investors.

"The only cost of this comprehensive slum-clearance program would be the amount of the annual subsidies. Over a period of sixty years, these subsidies would amount to less than the cost of the war for the next six months."

The nationwide program, with a goal of about 300,000 new homes a year for the next fifteen years, would represent an investment in slum clearance public housing of approximately $1,250,000,000 a year, he said.

Fuels on ASME Program

CLEVELAND—A symposium on domestic fuels is scheduled as part of the semi-annual meeting of the American Society of Mechanical Engineers to be held here June 8-10. The symposium is scheduled for Monday, June 8, at 8 p.m. The program follows:

Twenty Years' Progress in Domestic Oil Heating, R. J. Bender, Sinclair Refining Co.

A Domestic Stoker Designed to Burn Highly Coking Bituminous Coals Without Coke Tree Interference, S. W. Guthrie, Rochester & Pittsburgh Coal Co.

Tests of Heating Equipment at National Bureau of Standards, R. S. Dill, National Bureau of Standards.

Heating Wartime Housing, R. K. Thulman, Federal Housing Agency.

Recent Advances in Gas Utilization, F. E. Vandaveer, A.G.A. Testing Laboratory.

Elwood S. White

WASHINGTON—Elwood Sanger White of Old Greenwich, Conn., president of the United States Radiator Corporation, died here May 27 in the Emergency Hospital after a fortnight's illness, during which he underwent an operation. He had come to Washington on business. His age was 55.

Mr. White was graduated from Purdue University in 1908 and that fall began his career in the heating industry as a salesman for American Radiator Co.

During the next eight years he represented this organization at various times in Chicago, Boston and New York, and then left to become general manager of the Edward R. Ladew Company of Glen Cove, L. I., a post he held until 1920.

The next year Mr. White became president of Taco Heaters, Inc., of Stamford, Conn. In 1936 he assumed also the presidency of the United States Radiator Corporation, and in 1937 the presidency of the Pacific Steel Boiler Corporation as well.

He leaves a widow, a daughter and a son.

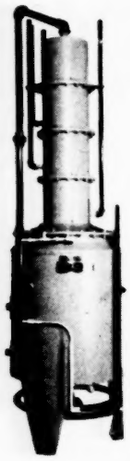
E. K. Lanning

CAMDEN—Emmanuel K. Lanning, 59, for many years sales manager of Warren Webster & Co., died May 26 at his home in Clayton, N. J., after a year's illness.

Born in Philadelphia, Mr. Lanning became associated with Warren Webster in 1903 as secretary to the late Theodore Webster, brother of the late Warren Webster, founder of the concern. Besides subsequently becoming head of the sales department, he also was assistant secretary and a member of the board of directors of the firm.

Surviving are his wife, a sister, and two grandchildren.

NEW EQUIPMENT

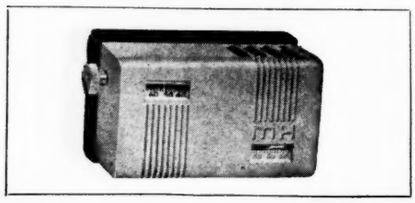


Cold Room Air Conditioner

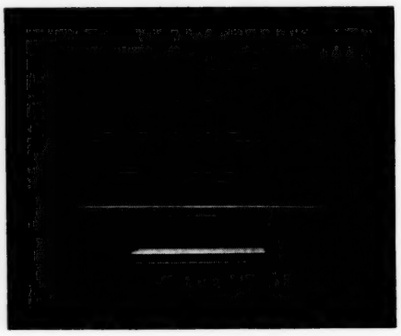
NAME—Niagara "No Frost" Cooler.
PURPOSE—To provide special test room temperatures of —50 to —80F for normalizing parts, materials and machinery.
FEATURES—Equipment consists of coolers operated in stages, the first reducing to temperature just above 32F and removing humidity; the second, removing the balance of the moisture; and the third stage producing and holding the required final temperature. Moisture is removed from the air below 32F without causing the formation of ice on coolers by a special method which employs "no frost" liquid continuously reconcentrated in a Niagara concentrator designed for this duty. Apparatus also introduces fresh makeup air into the room at correct low temperatures.
MADE BY—*Niagara Blower Co., 6 E. 45th St., New York.*

Heavy Duty Thermostat

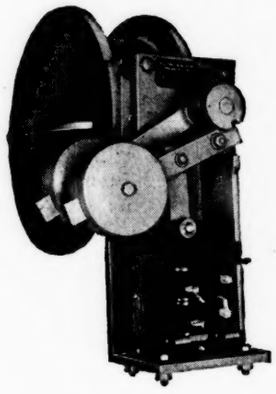
NAME—Minneapolis-Honeywell TA42A and TA42B thermostats.
PURPOSE—For controlling temperature in heating or refrigerating applications.
FEATURES—Type TA42A makes contact on temperature fall and is used for heating purposes. Type TA42B makes contact on temperature rise and is used for cooling. Both instruments furnished in horizontal design, which affords maximum air circulation about the element. Has heavy-duty snap-action switch, which is self-enclosed and protected from dirt, dust and grime, this switch being capable of directly handling large motor driven units, cold blowers, cooling equipment, industrial and commercial stoker fired heating plants, and the like. On larger or polyphase motors magnetic starter should be used in connection with thermostats. Instruments can also be used in low voltage circuits.
SIZES AND CAPACITIES—Several 30° ranges available for each instrument between 45 and 95F. Higher ranges available at extra cost. All types are non-adjustable with approximately 2° differential. Dimensions, 2-7/8 in. high × 2 3/16 in. deep × 5 in. wide.
MADE BY—*Minneapolis - Honeywell Regulator Company, Minneapolis, Minn.*



Equalizing Damper



NAME—Anemostat equalizing damper.
PURPOSE — For equalizing the distribution and controlling the volume of air flowing in round ducts to diffuser heads.
FEATURES—Consists of a louver-like arrangement of independently controlled blades mounted in a circular ring. When installed in a duct and the blades set at proper angle, the air flow can be controlled so as to give the desired condition at the diffuser head. Volume said to be controllable down to 40% of full amount. Easily installed by removing the diffuser head and slipping equalizing damper up into duct and fastening with sheet metal screws, or can be slipped through any suitable opening in main duct. Made of galvanized steel and sturdily constructed. Designed primarily for Anemostat system, but is said to be equally efficient on other diffuser installations.
SIZES AND CAPACITIES—Available in two main styles: one for large ducts of 20 to 38 in. diameter and the other for small or medium size ducts of 3 to 18 in. diameter.
LITERATURE AVAILABLE — Bulletin No. 16 from the manufacturer.
MADE BY—*Anemostat Corporation of America, 10 East 39th Street, New York, N. Y.*

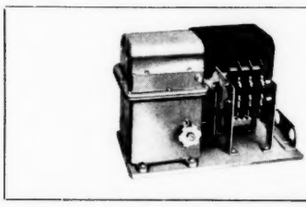


R-S Butterfly Valve

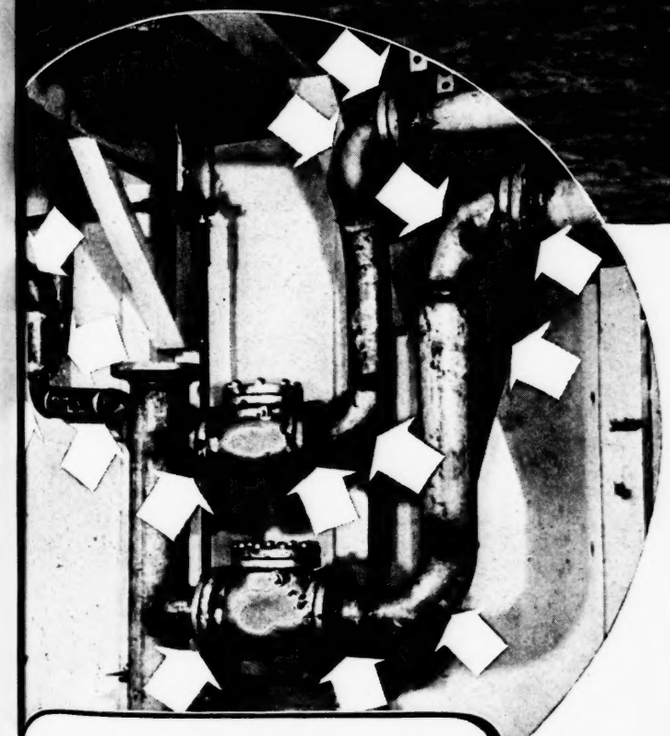
NAME — Solenoid operated butterfly valve.
PURPOSE—A quick, automatic action butterfly valve for emergency use.
FEATURES—Valve is said to provide two-position control—either automatic opening or wedge-tight shut-off in case the electric power fails or is turned off in an emergency. In an open position the butterfly vane is held open by the magnetic action of the solenoid. When the electric power is shut off the trigger is tripped and the counterweight closes the butterfly vane by gravity. Valve itself can be constructed of any metal alloy and in various sizes for air, gas, steam, oil, hydraulic and other services. Must be reset by hand.
MADE BY—*R-S Products Corporation, 4530 Germantown Ave., Philadelphia, Pa.*

Micro Program Switch

NAME—Micro program switch.
PURPOSE — To control operation of compressor motors, pumps, solenoid valves or motor-operated valves.
FEATURES — Consists of series of snap acting cam-operated switches with Microtrol driving unit. Adjustable cams may be rotated to change operation of switches. Timing driving unit is adjustable. Available with single-pole single-throw or single-pole double-throw switches.
LITERATURE AVAILABLE—Bulletin F-1420-3.
MADE BY—*Barber-Colman Company, Rockford, Ill.*



There are no "spills" at piping turns when TUBE-TURN fittings are on the job!



In this small area are *fifteen* places where Tube-Turn welding fittings and flanges are on the job—giving full protection against leakage and other maintenance worries. In any complete piping system, figure the hundreds of points where flow direction changes, and you'll see why Tube-Turn returns, elbows, tees, reducers, laterals, nipples, caps and flanges offer extra protection and trouble-free piping.

Disaster at the turns is an old story—

With spray flying and motors roaring, speed boats hurtle around the buoy-marked racing turns at break-neck speed! Cutting the curves too sharp or too fast means an upset—another case of failure at the turns.

The same danger lies at turns in *piping systems.* Wherever there is a change in flow direction, the strain imposed by the flow speed and pressure increases the probability of leakage and failure unless they're *welded* and *protected* with Tube-Turn welding fittings!

Write for helpful Tube-Turn data book and catalog.

TUBE-TURNS, INC., Louisville, Ky. *Branch offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Tulsa, Houston, Los Angeles. *Distributors in all principal cities.*

TUBE-TURN TRADE MARK — The FIRST WELDING FITTINGS 1ST AND STILL THE BEST — *Welding Fittings*

Penn Thermostat

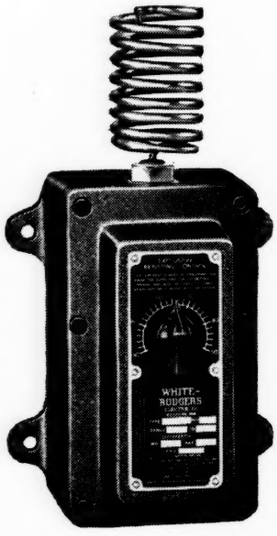
NAME—Series 872A11 thermostat.
PURPOSE—For controlling temperature in industrial and commercial unit heater applications.
FEATURES—This is a new line-voltage, two-wire thermostat incorporating "on" and "off" positions on a calibrated dial. In addition to performing regular automatic functions of the average thermostat, this instrument permits manual control of the unit heater motor. For instance, thermostat dial can be moved manually to the "off" position to prevent unit heater operation when doors are open. This "off" feature also acts as a convenient service switch or may be used to shut down unit heater during idle periods at night. For summer fan operation dial can be moved to "on" position causing unit heater motor to run continuously for ventilating purposes. Approved by Underwriters.
SIZES AND CAPACITIES—Maximum rating of ¼ hp, a-c, R.I.; 1/6 hp, a-c, S.P., 0.1 to 0.5 Amp. d-c. Maximum voltage 250 a-c or d-c.
LITERATURE AVAILABLE—Bulletin UH-1B available from manufacturer.
MADE BY—*Penn Electric Switch Co., Goshen, Ind.*

Skin-Protective Cream

NAME—Man-O skin-protective cream.
PURPOSE—For use in industry by workers handling skin-irritating materials.
FEATURES—This substance is rubbed into the hands, on the exposed portions of the arms, around the finger joints, and under the nails, before the worker starts his shift. Product is said to form a film-like, invisible and flexible glove protecting the skin from absorbing grease, cutting oils, paint, gasoline and other matters difficult to clean off. Said to be an effective guard against occupational skin irritations. Washes off easily with soap and water.
SIZES AND CAPACITIES—Available in 12-oz cans, sufficient for about 100 applications. Also in bulk.
LITERATURE AVAILABLE—Descriptive literature and samples available upon application to manufacturer.
MADE BY—*Sabern Products Co., 5511 Euclid Avenue, Cleveland, Ohio.*

Explosion-Proof Thermostats

NAME — White-Rodgers explosion-proof thermostats.
PURPOSE — To guard against explosions in refrigerating and air conditioning installations where hazardous atmospheres may exist.
FEATURES — Made in both self-contained and remote bulb types. Self-contained type recommended for controlling the temperatures of large air spaces and the remote bulb type for application in ducts, walk-in coolers, liquid baths and similar applications. All instruments are for full line voltage and are of the hydraulic-action type. External knob or tamper-proof internal adjustment available in both fixed and variable differential types. Fully approved by Underwriters; finished in black, baked crackle enamel.
SIZES AND CAPACITIES—The self-contained and remote instruments are made in four different types, all of 40 to 90F range and with fixed or adjustable differential of the internal or external type. Various contact arrangements available, permitting opening or closing on temperature rise. Motor ratings up to 1½ hp, 240 volts, a.c.
MADE BY — *White-Rodgers Electric Co., 1209 Cass Ave., St. Louis, Mo.*



Fuel Oil Meter

NAME—The Vesta fuel oil meter.
PURPOSE — For metering oil at one central point from which a group of oil-burning appliances are supplied, such as in national housing project heating.
FEATURES—Said to be based on a design entirely different from that of the conventional meter. Each time a chamber of the meter fills, a float rises and trips a counter to record the passage of 1/10 of a gallon. Manufacturer claims an accuracy within one quarter of 1% which is not affected by the speed or volume of the oil flow. The counter runs to 9999.9 and then repeats. Capital cost of such a pipe line system with central metering is said to be far less than it would be if individual tanks were used for each unit.
MADE BY—*Fluid Meters, Inc., Suite 3100, 60 Wall Tower, New York, N. Y.*

Gar Wood Heating Unit

NAME—Model 75 Tempered-Aire heating unit.
PURPOSE — For small and defense type homes.
FEATURES — Consists of an oil-fired vertical warm air heating unit having one motor operating both the blower and the fuel unit for the burner. The burner is identical to larger units as regards air and oil control and delivery to the fire. There is a heat exchanger operating on counterflow and downdraft principles which makes for increased efficiency and economy. This feature is said to reduce the stack temperature by about 100F.
SIZES AND CAPACITIES — Bonnet rating 75,000 Btu per hr; air delivery 750 cfm at 160F. Size of unit, 23½ in. wide x 57 in. high.
MADE BY—*Gar Wood Industries, Inc., Air Conditioning Div., Detroit, Mich.*

Looking for an efficient air cleaner?

WHEN IT COMES to efficiency, Fiberglas* Dust-Stop* Air Filters are aces high! They remove virtually all "nuisance" dusts harmful to varied manufacturing processes.

Dust-Stops are now at work in war production plants throughout the country. To many of these plants, the use of Dust-Stops means better, faster production . . . cleaner, more healthful working conditions, more accurate precision manufacture and fewer rejects, less time lost for plant clean-ups.

And Dust-Stops Bring You These Advantages

QUICK DELIVERIES: Made of 100% American materials, Dust-Stops are produced with no bottlenecks; distributors maintain ample stocks; deliveries are without delay!

CAPACITY: 2 CFM per square inch of area at 300 FPM.

RESISTANCE: Average resistance, new in inches of water gauge, .062 for 1-inch and .13 for 2-inch.

EASY TO CHANGE: Removing Dust-Stops requires no special skill or tools; it's as simple as changing your shoes, and quicker, too!

FIRE-SAFE: Dust-Stop's glass filtering material and non-combustible adhesive have been known to help stop the spread of fire.

ECONOMICAL: 1¢ per CFM to install, less than 1/10¢ per CFM to replace . . . that's all Dust-Stops cost. Further savings are possible when dust concentrations are heavy by cleaning them with a vacuum cleaner or by gently rapping out.

• • •

Order Dust-Stops from your air-conditioning manufacturer, jobber, dealer. *Or write us. Standard sizes available in No. 1 (1-inch thick), No. 2 (2-inches thick).*

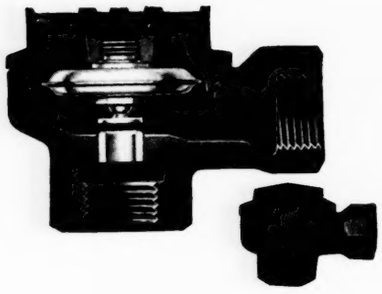
FIBERGLAS*

DUSTOP*

AIR FILTERS

*T. M. Reg. U. S. Pat. Off.

Made by Owens-Corning Fiberglas Corporation, Toledo, Ohio. In Canada, write to Fiberglas Canada, Ltd., Oshawa, Ontario.



Cast Iron Heating Specialties

NAME — Dunham Victory line of vapor and vacuum heating specialties.

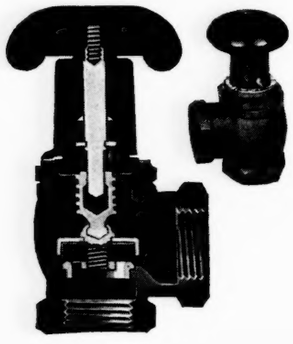
PURPOSE—To replace similar brass devices.

FEATURES—As part of the national conservation program, this company announces a line of new cast iron float and thermostatic traps, closed float traps, valves, return traps, strainers, unit heaters and pumps. The thermostatic radiator trap and packless radiator valve are shown in the illustrations. The trap, shown above, consists of two principal parts, a cast iron body with cuprous alloy valve seat and a cast iron cover containing the fluid-filled thermostatic disc. Connections are left hand tapped inlet and right hand outlet. The thermostatic elements are interchangeable in covers without gages. Cover and disc assemblies are interchangeable with former standard traps. The valve, shown below, is of a spring packed type with cast iron body and bonnet and non-breakable heat-resisting composition handle. Less than one turn of the handle opens the valve. Right hand tapped inlet and left hand outlet.

SIZES AND CAPACITIES—Trap available in ½ in. and ¾ in. sizes and the valve in ¾ and 1 in. sizes. Both items in angle pattern only, painted in gray enamel.

LITERATURE AVAILABLE—Descriptive bulletin called Victory line from manufacturer.

MADE BY—*C. A. Dunham Company, 450 E. Ohio Street, Chicago, Ill.*



Stoker-Fired Water Heater

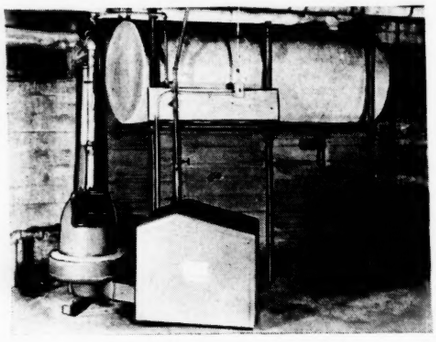
NAME—Gehl stoker-fired water heater.

PURPOSE—For heating water in homes, apartment buildings, stores, beauty parlors, restaurants, hotels and similar uses; also as a heating unit for filling stations and other small buildings.

FEATURES—This stoker is a miniature of the company's regular domestic models and has all their features except for a difference in coal and air feed tubes. Two different rates of coal feed are provided for through a double pulley arrangement, and transmission includes shear pin protection and throw-out lever. Air governor is used. The air chamber is designed also to act as a base to carry the boiler and is fitted with leg adjustments to compensate for unevenness of the floor. Water temperature controlled by aquastat, which starts and stops stoker. Hold fire timer also included, and this starts the stoker at regular intervals to prevent fire from going out during long "off" periods. A fused disconnect switch is built into the equipment.

SIZES AND CAPACITIES—Available in two sizes with coal feeds of 5 to 7 lb or 7 to 9 lb per hour, with ⅛ hp motor.

MADE BY—*Gehl Brothers Mfg. Co., West Bend, Wis.*



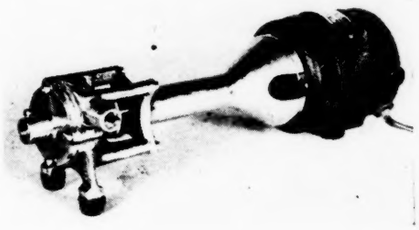
Chemical Sprinkler System

NAME—Bancroft automatic chemical sprinkler system.

PURPOSE—For extinguishing fires by automatic sprinkler head type of system with use of special liquid in place of water.

FEATURES — Chemical sprinkler heads, which work just like water heads, are connected by piping to a tank full of the patented extinguishing liquid, and an electrically-operated compressor maintains pressure throughout the system automatically. When released by melting of fusible element liquid is sprayed upon fire where heat vaporizes it, forming a heavy vapor blanket. This is said to cool and smother many types of fires, including magnesium.

MADE BY—*Bancroft Chemical Sprinkler Co., 82 Foster St., Worcester, Mass.*



Eastern's Hot Liquid Pump

NAME—Model EH hot liquid pump.

PURPOSE—For handling thin liquids at temperatures up to 500F.

FEATURES—A centrifugal type pump with motor direct-connected through a 5 in. heat radiating tube. Shaft supported by outboard ball bearings. Stuffing box accurately adjustable by adjustment ring. Manufactured in stainless steel, monel metal, chromium-plated bronze, Hastelloy C, and other alloys.

SIZES AND CAPACITIES — Weight, 7 lb. Size of unit 12 in. long, 4 in. wide, 4½ in. high; 1/20 hp. Universal fan-cooled motor for 115 volt A.C. or D.C. Rubber-covered cord with feed through switch. Maximum capacity, 7½ gpm with 21 lb per sq in. maximum operating pressure.

NAME — *Eastern Engineering Company, 45 Fox St., New Haven, Conn.*

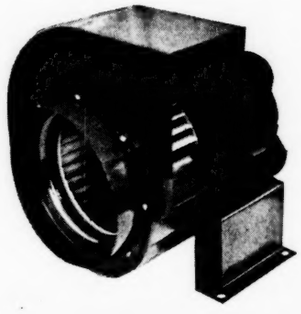
Single Inlet Blower

NAME—Lau single inlet blower.

PURPOSE—For general ventilating applications.

FEATURES—This blower is said to be particularly useful in exhausting objectionable or hazardous fumes from small enclosures, such as welders' work rooms, kitchens and the like. This single inlet blower in wheel sizes from 5 in. to 9 in. diameter can be furnished with direct drive using either a.c. or d.c. motor, or with belt drive. Larger sizes supplied upon receipt of specifications, including rotation and type of drive.

MADE BY—*Lau Blower Company, Home and Orchard Avenues, Dayton, Ohio.*



BETHLEHEM GALVANIZED STEEL SHEETS

Here's a sheet-metal installation that's got a big job cut out for it—supplying pure, conditioned air for a windowless "black-out" building recently constructed in a large arms plant. The illustration showing a workman putting final touches on the interior of the main duct gives a good idea of the size of the job.

As in many another vital war job, Bethlehem Galvanized Steel Sheets were used throughout. The easy-forming qualities of Bethlehem Sheets were an advantage in fabricating the job, and their tight, even coating of highest-grade zinc can be depended upon to resist checking and to fight off corrosive attack.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

Econostat

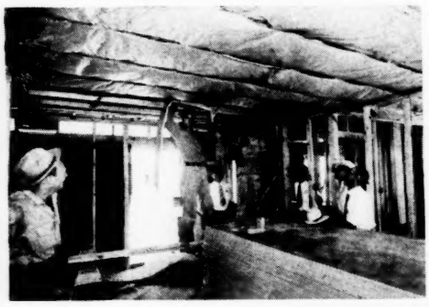
NAME—Econostat.
PURPOSE—For regulating the heating system in buildings which can not be satisfactorily controlled from a single thermostat.
FEATURES—Device regulates heating system directly from the outdoor temperature by supplying heat at intervals. It maintains desired indoor temperature by varying the *heat on* periods in accordance with outdoor temperature changes. Thus, heat supplied to the building is in proportion to heat loss from building and not dependent upon temperature in any particular room. Completely automatic. For either new or existing buildings; will control system fired by gas or oil burner, stoker, or central station steam.
LITERATURE AVAILABLE—Bulletin F-1647-1.
MADE BY—*Barber-Colman Company, Rockford, Ill.*

Zeolite Softener Improvement

NAME—Elgin "double check" zeolite softener equipment.
PURPOSE—To evenly distribute the flow of water through zeolite water softeners and to prevent loss of zeolite.
FEATURES—System consists of a number of combination check valve and strainer devices located over the top of the bed of zeolite and a somewhat similar system of strainers located in the bottom of the softener. Water entering at the top passes out through the check valves and disburses uniformly over and down through the zeolite pack, thence out through the bottom strainers. During regeneration the salt solution circulates in the same way. In the backwash operation water enters through the bottom strainers, passes upward through the zeolite pack and out through the strainer portion of the combination strainer and check-valve devices at the top. The installation of this system is claimed to give 44% greater zeolite softening capacity than a conventional softener of equal size. This is accomplished by the action of the strainers and check valves which are said to keep the zeolite within the softener and permits a deeper bed which gives this greater capacity. This system is an integral part of the company's standard softeners, but existing softeners can be equipped with it simply by replacing present manifolds with the double-check type.
SIZES AND CAPACITIES—Available in capacities and sizes covering all requirements.
LITERATURE AVAILABLE — Bulletins 605 and 606.
MADE BY—*Elgin Softener Corporation, Elgin, Illinois.*

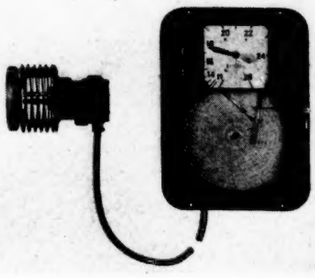
Blanket Insulation

NAME—Defense blanket insulation.
PURPOSE—Especially developed for insulating defense homes.
FEATURES—A completely sealed insulation covered by a waterproof paper on both sides. Flanged on the edges for quick, permanent application. Can be applied equally well on the job or in pre-fabricating work. Light in weight, easy to handle and low in cost.
SIZES AND CAPACITIES—Available in rolls or may be cut in varying lengths to fit job requirements.
MADE BY—*Wood Conversion Company, First National Bank Bldg., St. Paul, Minn.*



Metal Lead Primer

NAME—Hyspar metal lead primer.
PURPOSE—Used as an alternative for aluminum paint undercoating.
FEATURES—Said to be equal in protective value to that of a good grade of aluminum paint. Claimed to be rust inhibiting and to possess an unusual protective ability with high elasticity. Paint will not crack or flake off, holds tight to metal under rapid climatic changes, and is highly resistant to salt air. It may be brushed, sprayed or dipped, and dries in from four to five hours. Color is neutral gray. Available either premixed ready for use or in separator cans with the metal paste separate from the liquid.
MADE BY — *The Midland Paint & Varnish Company, Cleveland, Ohio.*



Bristol Radiation Pyrometer

NAME—Pyrovac radiation pyrometer.
PURPOSE—For recording, indicating, or automatically controlling temperatures in furnaces and kilns above 900F.
FEATURES—Has temperature sensitive radiation head mounted on outside of furnace out of the hot zone where heat rays emitted from the object under measurement are picked up, registering the object's surface temperature. Intended by manufacturer for applications where temperatures are in excess of thermocouple range or where rare-metal thermocouples are used. Also, for measuring temperatures of furnace roofs and walls, retort linings, and the work itself, rather than furnace atmospheres. Can be used where object is moving, is inaccessible, or where space is limited.
MADE BY—*The Bristol Company, Waterbury, Conn.*

Liquid Level Controls

NAME—Penn float controls series 110 and 152.
PURPOSE—For starting and stopping electric motors by changes in liquid level.
FEATURES—These two series of controls are used to control liquid levels for open tank or sump operations. In either series they may be reversed from one style to the other simply by changing pivot location of the operating arm lever. Both types have heavy-duty contact structure, double-break design, actuated by the company's exclusive V-over-roller trip mechanism. Contacts are of silver and are accessible without dismantling. Operating parts are carefully heat-treated for long life. Close-fitting cover can be removed for wiring and service.
SIZES AND CAPACITIES—Series 152 available in two pole construction up to 1 hp, 550 volt maximum capacity; series 110 may be had in single, double, or three pole construction up to 3 hp, 550 volt, maximum capacity. Choice of contact arrangements for either control.
LITERATURE AVAILABLE — Bulletins 1911 and 1912 covering series 110 and 152, respectively.
MADE BY—*Penn Electric Switch Company, Goshen, Indiana.*

DEPENDABILITY

Proof that a Carrier Centrifugal Refrigeration Machine will give you dependable operation at Low Cost . . . year after year

365 Days Around the Clock is the operating schedule of the Carrier Centrifugal Refrigeration machine installed in the blast furnace of the Woodward Iron Company, Birmingham, Ala.

20 Years Service is the record of the first Carrier Centrifugal installed at the Onondaga Pottery Company, Syracuse, N. Y.—still operating as efficiently as ever.

7200 Hours A Year. The Carrier Centrifugal at the Narragansett (R. I.) Brewery operates on an average of 7200 hours a year—and brings the owner large annual savings.

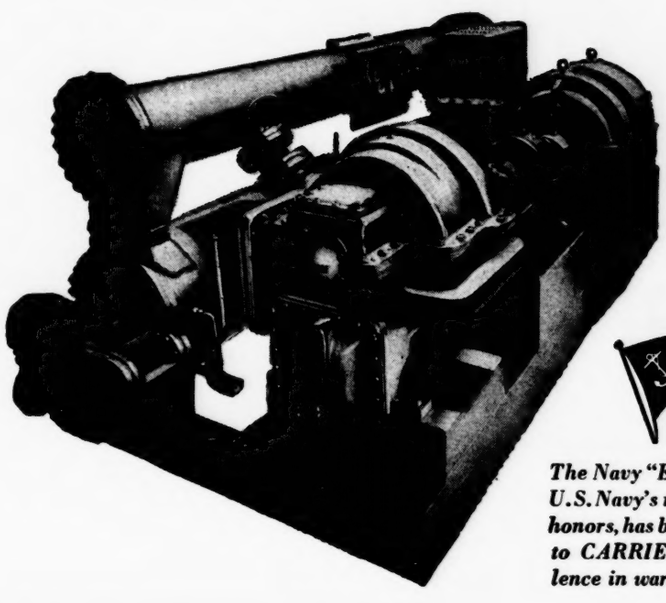
24 Hours A Day. Operating 24 hours a day every day, the Carrier Centrifugal Refrigeration Machine at the Skenandoa Rayon Corp., Utica, N. Y. has drastically cut processing and refrigeration costs.

More Than 1000 In Use. Dr. Willis H. Carrier invented the Centrifugal Refrigeration Machine which represents the greatest improvement ever developed in mechanical cooling. Whether your requirement is for a minus 100° F. or for 1200 tons of water chilling capacity, the new range of Carrier Centrifugals takes care of every need—will meet your refrigeration requirements more efficiently, dependably and at low operating costs. The operating records of the Carrier Centrifugal Refrigeration Machines cover two decades.

Just a Few Operating Records

WHERE INSTALLED	YEAR INSTALLED	AVERAGE HOURS PER YEAR
Convention Hall	1929	3,000
Printing Plant	1929	6,000
Textile Mill	1929	4,254
Rayon Manufacturer	1930	7,200
Drug Manufacturer	1938	3,946
Cosmetic Manufacturer	1936	6,612
Brewery	1935	7,200
Chemical Manufacturer	1933	5,000
Hospital	1934	7,200
Fruit Storage	1933	2,400
Hotel	1934	7,200
Broadcasting Studio	1930	3,100

RECORDS LIKE THESE COME ONLY FROM DEPENDABLE OPERATION!



The Navy "E", one of the U.S. Navy's most coveted honors, has been awarded to CARRIER for excellence in war production.

Carrier
Centrifugal
REFRIGERATION

Our New 42-page Booklet Has the Most Complete Data on Centrifugal Refrigeration Ever Published!

CARRIER CORPORATION Syracuse, N. Y.
"Weather Makers to the World" Desk F50

Without obligation, send new free booklet "20 Years of Centrifugal Refrigeration."

Name_____

Company_____

Address_____

Number of Degree-Days for April, 1942

City	Degree-Days Apr., 1942	Degree-Days Apr., 1941	Degree-Days Season 1941-42 Sept. 1-April 30
Albany, N. Y.	464	408	6212
Alpena, Mich.	549	590	6767
Anaconda, Mont.*	1080	892	7097
Atlanta, Ga.	119	88	2895
Atlantic City, N. J.	399	382	4323
Baker, Ore.	550	565	6530
Baltimore, Md.	234	213	3781
Binghamton, N. Y.	426	393	5811
Birmingham, Ala.	89	42	2572
Bismarck, N. D.	570	580	7513
Boise, Idaho	398	448	5755
Boston, Mass.	463	409	5224
Bozeman, Mont.*	1170	886	7492
Buffalo, N. Y.	551	501	6003
Burlington, Iowa	295	—	4298
Burlington, Vt.	585	517	7075
Butte, Mont.*	1180	957	7853
Cairo, Ill.	170	133	3673
Canton, N. Y.	545	522	7249
Charles City, Iowa	373	378	6391
Charlotte, N. C.	122	113	2866
Chattanooga, Tenn.	160	119	3481
Cheyenne, Wyo.	600	731	6934
Chicago, Ill.	370	396	5314
Cincinnati, Ohio	279	227	4437
Cleveland, Ohio	389	413	5192
Columbia, Mo.	204	216	4369
Columbus, Ohio	325	247	4774
Concord, N. H.	555	424	6673
Concordia, Kan.	253	293	4934
Davenport, Iowa	298	302	5344
Dayton, Ohio	327	267	4793
Denver, Colo.	399	547	5636
Des Moines, Iowa	282	301	5534
Detroit, Mich.	401	393	5583
Dodge City, Kan.	298	338	4660
Dubuque, Iowa	328	332	5693
Duluth, Minn.	619	628	7687
Eastport, Me.	718	700	6993
Elkins, W. Va.	368	340	5130
El Paso, Tex.	97	152	2389
Erie, Pa.	407	452	5397
Escanaba, Mich.	633	640	7080
Evansville, Ind.	247	205	4311
Fort Smith, Ark.	94	85	3093
Fort Wayne, Ind.	379	352	5627
Fort Worth, Tex.	77	72	2375
Grand Rapids, Mich.	374	363	5598
Green Bay, Wis.	456	492	6488
Greensboro, N. C.	195	195	3647
Harrisburg, Pa.	303	256	4772
Hartford, Conn.	433	378	5542
Helena, Mont.	585	625	7964
Huron, S. D.	424	436	6601
Indianapolis, Ind.	275	233	4664
Ithaca, N. Y.	446	418	5933
Kansas City, Mo.	185	207	4334
Kewanee, Ill.	234	255	4944
Knoxville, Tenn.	171	119	3489
La Crosse, Wis.	345	328	6141
Lander, Wyo.	530	714	7917
Lansing, Mich.	420	404	5992
Lewiston, Me.	620	547	6947
Lincoln, Neb.	266	332	5324
Little Rock, Ark.	111	70	2979
Livingston, Mont.*	998	875	6416
Los Angeles, Calif.	168	177	1230
Louisville, Ky.	214	178	3991
Lynchburg, Va.	187	165	3529
Madison, Wis.	408	401	6201
Marquette, Mich.	519	590	6932
Memphis, Tenn.	113	76	3227
Milwaukee, Wis.	469	476	6209
Minneapolis, Minn.	400	378	6557
Nantucket, Mass.	578	553	5149
Nashville, Tenn.	147	95	3404
New Haven, Conn.	431	355	5091
New Orleans, La.	26	0	1349
New York, N. Y.	360	291	4621
Nome, Alaska	1783	1640	9101
Norfolk, Va.	208	203	3005
Northfield, Vt.	630	566	7446
North Platte, Neb.	350	436	5837
Oklahoma City, Okla.	136	148	3335
Omaha, Neb.	271	303	5577
Oswego, N. Y.	533	523	6136
Parkersburg, W. Va.	274	220	4448
Peoria, Ill.	304	298	5166
Philadelphia, Pa.	292	236	4253
Pittsburgh, Pa.	310	253	4668
Pocatello, Idaho	525	633	7229
Portland, Me.	610	557	6678
Portland, Ore.	323	256	3826
Providence, R. I.	445	376	5180
Pueblo, Colo.	399	469	5595
Raleigh, N. C.	153	140	3013
Reading, Pa.	304	258	4650
Reno, Nev.	523	562	5417
Richmond, Va.	199	192	3528
Rochester, N. Y.	460	468	6087
Roseburg, Ore.	374	350	3747
St. Joseph, Mo.	205	247	4771
St. Louis, Mo.	204	186	4077
Salt Lake City, Utah	437	508	5956
Sandusky, Ohio	377	404	5212
San Francisco, Calif.	284	277	2136
Sault Ste. Marie, Mich.	634	585	7838
Scranton, Pa.	385	332	5463
Seattle, Wash.	366	296	3841
Sioux City, Iowa	359	360	6159
Spokane, Wash.	455	397	6050
Springfield, Ill.	246	239	4631
Springfield, Mo.	195	196	4318
Syracuse, N. Y.	453	453	6060
Tacoma, Wash.	388	341	4179
Terre Haute, Ind.	256	219	4519
Toledo, Ohio	369	380	5434
Trenton, N. J.	333	274	4648
Utica, N. Y.	463	403	6402
Washington, D. C.	229	204	3877
Wichita, Kan.	206	247	4334
Yakima, Wash.	330	280	5151

Figures in this table, with eight exceptions, are calculated by HEATING AND VENTILATING from local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, and Sioux City, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill., and Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company. HEATING AND VENTILATING will welcome an opportunity to make arrangements with readers who are keeping degree-day records over a period for important communities not listed above in order to make such data available to the industry.

*These figures are for March, 1942; March, 1941; and Season 1941-42 to March 31, respectively.

Conserve Fuel!
Control Steam!
No matter what your problem—large or small—in the handling of steam, air or condensate, installing
ILLINOIS
STEAM SPECIALTIES
will insure maximum service and economy.
ILLINOIS Heating Systems—Vacuum, Vapor, Selective Pressure Control, Continuous Flow Control, Intermittent Flow Control, cover the complete range of heating requirements. Each admits of special variations to meet any condition whether for heating or process work.
In addition to low pressure specialties we manufacture complete lines of steam power specialties for medium and high pressures.
Our specialists will be glad to assist and give you every cooperation. Write us, or phone the representative nearest you in our nation-wide service.
ILLINOIS ENGINEERING CO.
Eclipse
CHICAGO

ILLINOIS ENGINEERING COMPANY
2047 SOUTH RACINE AVENUE, CHICAGO

NEW TRADE LITERATURE

Copies of catalogs and bulletins reviewed in this section are generally available without charge, unless otherwise mentioned. Address request direct to the manufacturer on your business letterhead.

Feed Water Level Controllers. Bulletin covers two improved types of controllers — pilot-operated and rotary types. Adoption of the cantilever principle multiplies expansion and contraction in the tube by six, which permits wide range of movement for valve motivation and makes possible the use of a much smaller valve, according to the manufacturer. Bulletin also describes other recently introduced products of the company, including the Campbell Micro-Bean, which is a universal pulsation dampener for eliminating vibration of gauge needs and provides sensitive valving to pump governors; thermometer wells made of stainless steel; gas samplers; and feet gauge strips. The latter are cast in 12 in. lengths for mounting on a surface board to be fastened to tanks. The numerals can be arranged to read up or down. J. A. CAMPBELL COMPANY, 651 WARDLOW ROAD, LONG BEACH, CALIF.

Refrigeration Control. In keeping with the conservation keynote featured at the recent All-Industry meeting of the Air Conditioning and Refrigerating Engineers, a 4-page two-color, self-mailing folder is being distributed to the company's distributors and jobber customers, who are being urged, in turn, to mail the folders to their service engineers. The company offers to imprint the folders and furnish them free to customers. Folder is entitled "Let's Pull Together" and recommends conservation in refrigeration work wherever possible and includes information and illustrations on the company's line of instruments. PENN ELECTRIC SWITCH CO., GOSHEN, INDIANA.

Temperature Indicators. A new bulletin No. A-305 covering potentiometer indicators and indicating resistance thermometers. Instruments illustrated and described include single-point and multiple-point models, models equipped with selective key-switches with as many as 82 contact points, and portable models. Single range and double range dials are shown in full size reproductions and a complete list of standard ranges given. Constructional features of the instrument included. THE FOXBORO COMPANY, FOXBORO, MASS.

Pumps. Complete engineering data on the company's SS Unit pumps and the Electrifugal appears in the 36-page standard-size Bulletin B6018B. Head capacity tables and dimension charts make it easy to select proper pumps for individual applications. Performance data and engineering recommendations, also part of the bulletin, are additional aids in the selection of units for pumping more gallons at less cost. Cross sections and construction details help to illustrate this complete pump line. ALLIS-CHALMERS MFG. CO., MILWAUKEE, WIS.

Unit Heaters. A standard size, 12-page catalog No. 770, illustrating and describing the McQuay unit heater for diesel engine heat recovery. Shows how waste heat in cooling water can be utilized for space heating by passing the water through unit heaters. Gives construction details and selection data, also tabulated performance data, installation details and wiring diagrams. MCQUAY, INC., MINNEAPOLIS, MINN.

Boilers. As an aid to power engineers faced with the necessity of meeting sharply increased steam demands and who will be obliged to operate their boiler plants on a 168-hour week schedule, a 20-page bulletin, No. 16, entitled How to Safely Stretch Steaming Capacity has been prepared. Numerous suggestions are made under the headings of: Check Condition of Boiler and Furnace, Check Operating Procedure, Check Possibilities for Modernization, and Base Daily Operation on Accurate Measurements and Records. Many of the suggestions made can be carried out without the use of elaborate metering or control equipment. The bulletin is really a check list of procedure for boiler room improvement. BAILEY METER CO., CLEVELAND, OHIO.

Blowers. A new standard size, 76-page catalog No. 303, published in two sections. Part I is a 20-page bulletin in two colors with photographs showing various drive arrangements and discharges in both single and double width blowers. Complete construction features and performance characteristics are included. Part II of Catalog 303 has 40 pages of engineering data and capacity tables covering performances of both forwardly and backwardly curved blowers. In addition 16 pages are devoted to drawings and illustrations. AUTOVENT FAN AND BLOWER DIV., THE HERMAN NELSON CORP., 1811 NORTH KOSTNER AVE., CHICAGO, ILL.

Temperature Control. Bulletin No. 600. A standard size 16-page catalog covering the company's line of temperature regulators for heat control in industry. Self-contained temperature regulators for hot water heaters, process tanks, fuel oil storage, dry kilns, ovens and other applications, are shown in photograph form and with diagrammatic installation information. Prices, sizes, weights, and so forth, are given. Instruments for remote control are also included as well as charts showing valve capacities. SARCO COMPANY, INC., 475 FIFTH AVE., NEW YORK.

Fans. This standard size, 26-page catalog, Unit X4549, illustrated in color, shows approximately a hundred types of the company's line of propeller type fans with complete data on construction features and performances. Cutaway views and circulation diagrams together with tables of specifications give a complete picture of the fans available. The same information also available in a 24-page pocket-size catalog, Unit X4514. THE EMERSON ELECTRIC MFG. CO., ST. LOUIS, MO.

Boilers. An eight-page booklet, Bulletin G-34-A, describing its integral-furnace boiler classes 9, 12, and 15 for lower capacities (as low as 135 hp or 9000 lb steam per hr) and for stoker or oil firing. Contains many illustrations and drawings defining details of operation and construction features in this new design of boiler and indicating principal dimensions for various standard sizes. THE BABCOCK & WILCOX COMPANY, 85 LIBERTY STREET, NEW YORK, N. Y.

Blow-Off Valves. A standard size, 32-page, two-color, profusely illustrated catalog which describes the company's quick operating valves for blow-off, water column, and other boiler room services. Complete tables of specifications, dimensions, and prices included. EVERLASTING VALVE COMPANY, 49 FISK STREET, JERSEY CITY, N. J.

Instrument Springs. A 12-page, standard size booklet illustrating and explaining some of the typical problems experienced in the use of springs of various kinds in automatic control instruments. ALL-WEATHER SPRINGS, 72 WASHINGTON STREET, NEW YORK, N. Y.

(Continued on page 84)

To our many friends who have helped make our first 50 years successful

we wish to thank you for your support in the past and to express the hope that we may have the privilege of serving you in the years to come.

THE POWERS REGULATOR COMPANY

Offices in 47 Cities

50 Years of Automatic Temperature and Humidity Control

NOZZLES for Air Washing

Yarway Involute Design—with no internal parts or vanes — insures non-clogging trouble-free service. Sizes and types to meet all requirements. Successful installations of Yarway Involute Nozzles in water cooling and air conditioning service total more than 5 million gallons per minute. Write for Bulletin N-615.

YARNALL-WARING CO., PHILA.
104 MERMAID AVENUE

YARWAY

NOW! ACCURATE AIR VELOCITY MEASUREMENTS at INTAKE GRILLES!

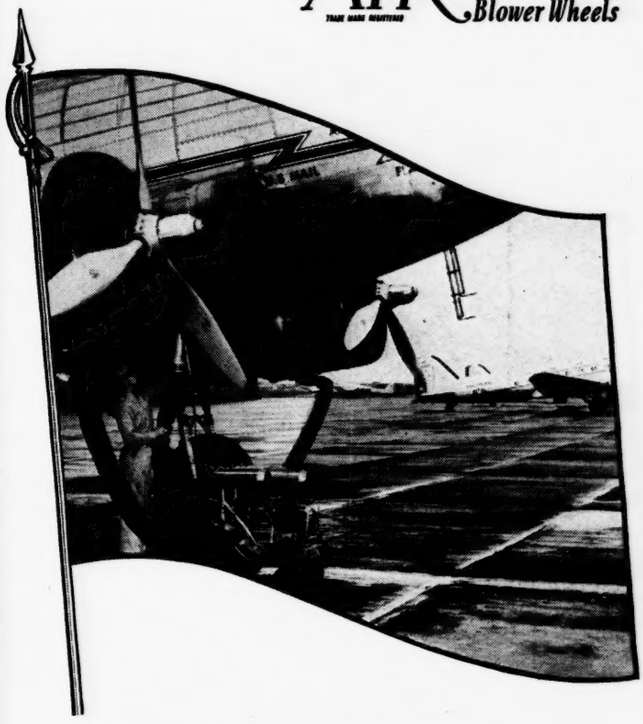
This new jet attachment can be added to existing Tube-type Velometers now in use, or can be purchased with other standard jets and new Velometers. The new intake grille jet is offered only in the spot type since the center reading only has proven to be sufficiently accurate for all commercial purposes. *Write for information.*

Illinois Testing Laboratories Inc.

143 W. Hubbard St., CHICAGO, ILL.

AIR for the United States ARMED FORCES

from AIROTOR Blower Wheels



HERE is another unit in which Torrington Airotor Blower Wheels are serving our armed forces and the public.

The portable "ground heater" illustrated is used by the Army Air Corps and by commercial air lines for preheating airplane engines and cabins, saving much valuable aviation gasoline previously required for warming up engines on the ground. The Airotor Blower Wheel drives heated air through flexible hose to special connections under the plane.

Only a sturdy and carefully balanced fan will withstand this high speed gasoline engine application, yet the Airotors used are of our standard design from regular production.

The proper Airotor for each application may be easily selected from our dependable performance charts. Free samples will be supplied for further test.

TORRINGTON

MANUFACTURING CO., TORRINGTON, CONN.

When Uncle Sam took off his jacket . . .

He took off OURS too!

Off come the jackets . . . boilers too must be stripped to contribute to fighting action.

What about "after the war?" Will jackets be metal . . . or plastic? Will they look like last year's . . . or be entirely new? There's no way of knowing.

But of this you *can* be sure. Even when National Boilers get their jackets back on, National researchers will still have theirs off. For National's research goes on forever—to improve heating plants, and to develop new, better products to introduce tomorrow. Leadership in making heating equipment more useful and more attractive will continue to be our goal.

For *after* the war, National promises you a line of equipment to match the unparalleled business opportunities the heating field will offer you. For *today,* National offers a broadside that tells you where to find *current business.* If you have not received your copy, send for it.

"NATIONAL" is participating in the ARMAMENT PROGRAM

IN TRYING TIMES . . . KEEP TRYING!

THE NATIONAL RADIATOR COMPANY
221 CENTRAL AVENUE, JOHNSTOWN, PA.

Pumps. Features of class GT two-stage centrifugal pumps are illustrated in a 12-page, 2-color standard size bulletin 7167 containing 28 photographs and cross-sectional views, extensive performance tables, and a comprehensive tabulation showing friction of water in various sizes of pipe. INGERSOLL-RAND CO., 11 BROADWAY, NEW YORK, N. Y.

Fans. A new 24-page standard size catalog for 1942 illustrating and describing the company's line of attic and kitchen ventilators, window exhaust fans, louvers and accessories. Two pages are devoted to illustrating and describing industrial applications. REED UNIT-FANS, INC., 811 ST. CHARLES ST., NEW ORLEANS, LA.

Rubber Conservation. A two-color, 11 x 17½ in. cardboard wall poster, designed to be hung on bulletin boards, giving eight important rules to be followed in order to best conserve the available rubber supply. B. F. GOODRICH COMPANY, AKRON, OHIO.

Insulation. Standard size, eight-page, two color catalog on industrial and commercial building and equipment insulation. Includes application data and sketches. SPRAYO-FLAKE COMPANY, 2715 IRVING PARK ROAD, CHICAGO, ILL.

Air Flow. A four-page, standard size bulletin No. 16, illustrating and describing the company's new equalizing damper used for control of uniformity, volume, and direction of air discharging from Anemostats. ANEMOSTAT CORPORATION OF AMERICA, 10 EAST 39TH STREET, NEW YORK, N. Y.

Refrigeration. A 38-page standard size catalog J-104-E illustrating the company's line of refrigeration valves, fittings, charging hoses, strainers, receivers, and other miscellaneous accessories used in refrigeration work. THE WEATHERHEAD CO., CLEVELAND, OHIO.

Gas Burners. Standard size, six-page bulletin A1A30G4, giving the uses and specifications of the Glowan line of gas burners for boilers and furnaces. DISTRIBUTED BY J. O. & C. U. MARTIN, 637 MINNA ST., SAN FRANCISCO, CAL.

Radiation Pyrometers. Bulletin P1102, describes the company's newly developed line of Pyrovac radiation pyrometers. Folder is liberally illustrated with engineering drawings showing methods of use. THE BRISTOL COMPANY, WATERBURY, CONN.

Insulation. A standard size, 16-page catalog illustrating the company's line of mono-block, rockwool blanket, loose rockwool, and pipe covering types of insulations. BALDWIN-HILL CO., 529 KLAGG AVE., TRENTON, N. J.

Ejectors. A standard size 8-page bulletin W-205-B9 in color devoted to the company's three-stage steam ejectors. WORTHINGTON PUMP AND MACHINERY CORPORATION, HARRISON, N. J.

Welding. A two color, 12 page bulletin, 10 by 14 inches, entitled "Sparks," showing some interesting applications of welding in industry. TUBE-TURNS, INCORPORATED, LOUISVILLE, KY.

Heating. A new 1942 edition of the company's catalog on radiators and boilers has just been issued giving information on slim tube radiators and lightweight Aero convectors, as well as the latest information on current market conditions. THE NATIONAL RADIATOR COMPANY, 221 CENTRAL AVENUE, JOHNSTOWN, PA.

Synthetic Rubber. A standard size, 4-page, catalog section 8010 giving information on manufacturer's recently-announced synthetic rubber sponge. Properties are described and dimensions given for stock sizes of available slabs, tubing, cord and molded shapes. Interesting feature of the folder is a table comparing the properties of the new synthetic rubber with the natural rubber sponge. B. F. Goodrich Company, Akron, Ohio.

Unit Air Conditioners. A series of four bulletins, each standard size, single sheet, devoted to the company's self-contained Weathermakers, types 41B2, 41B3, 41B6 and 41B7, all designed for use in commercial establishments requiring conditioning. Carrier Corporation, Syracuse, New York.

Controls. Standard size 36-page catalog No. 900E, describing and illustrating company's complete line of non-indicating temperature and pressure controllers, diaphragm valves and accessories. Two new instruments are included: No. 42 temperature or pressure controller, and a self-operating temperature controller. C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y.

Remote Control Damper Regulators. An eight-page standard size Catalog No. 2 featuring manually-operated remote control regulators for dampers, together with other damper regulating devices of the conventional type. A four-page reprint showing a typical installation is available upon request. The Young Regulator Company, 4500 Euclid Ave., Cleveland, Ohio.

Controls. Standard size, 16-page bulletin 1508-G, giving complete information on company's line of automatic heating controls. Illustrations and application data included. Penn Electric Switch Co., Goshen, Indiana.

Humidifiers. An 8-page folder entitled "You Are Harboring a Thief" and explaining the principles of humidifying for homes and offices. Carrier Corporation, Syracuse, New York.

Pyrometers. A standard size 36-page catalog No. 1101-G covering Tag pyrometers. C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y.

Motor Drives. An attractive, spirally-bound, 32-page bulletin B-3044 illustrating motor drives, gearing, and control for industrial and air conditioning systems. All items covered are illustrated by installation views of typical applications. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Blowers. A new catalog SD1141 covering standard duty blowers complete with performance ratings, dimensions, discharges and drive arrangements. In addition, covers enclosed drive blower sets, twin and triple blowers, and other air moving equipment. Also, a new folder No. 5003, illustrating various types of air moving equipment including blowers, spot fans, all year conditioners, propeller fans and industrial exhausters. Utility Fan Corporation, Los Angeles, Calif.

Stokers. Two-page leaflet F-1 giving description of a recently-developed coke stoker. Lists advantages and illustrates operating principles. Koppers Company, Pittsburgh, Pa.

FIND OUT HOW LITTLE

PERMANENT

CONDUIT COSTS

ADSCO BANNON TILE IS THE MOST ECONOMICAL *Permanent* FORM OF CONDUIT

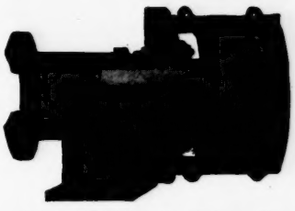
Engineers realize that the heat loss from makeshift steam lines can be very costly for the duration.

This is why more and more ADSCO-Bannon Tile Conduit is being ordered for the steam and hot water lines at army camps — naval and air bases, defense plants and housing projects. Available with base drain, in sizes from 4"- 24" inclusive, with ADSCO Filler Insulation — a "Fiberglas" product, it makes a PERMANENT installation of high thermal efficiency.

Find out how little it costs to have PERMANENT steam lines. With the facilities of our big tile plant, chances are we can save you valuable time. Write for quotations or Bulletin No. 35-67V.

ADSCO MAKES COMPLETE STEAM LINE EQUIPMENT

Write for complete Catalog No. 35V which describes and illustrates the complete line of ADSCO Products.



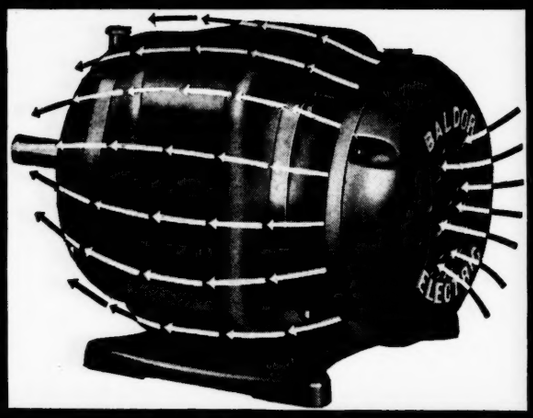
ADSCO Internally-Externally Guided Expansion Joint

Save yourself unnecessary correspondence and phone calls — avoid the hazards of divided responsibility — maintain a better working schedule by ordering all your steam line equipment from ADSCO—Conduit—Insulation — Expansion Joints — Pipe Line Accessories, etc.—everything you need for efficient and economical steam line installations.

AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA, N. Y.

Making "UP-TO-DATE" Steam Line Equipment for over 60 years

TOTALLY ENCLOSED
(DUST-PROOF) MOTORS
AT NO EXTRA COST



Illustrating forced-air cooling over entire exterior of motor frame.

BALDOR offers you totally enclosed, dust-proof motors of Streamcooled design in integral sizes at same prices as standard motors.

When you specify BALDOR, you get Special Motor features at NO EXTRA COST to you.

(If required, Class 2, Group G, Underwriters' label furnished at slight additional charge.)

BALDOR ELECTRIC COMPANY, ST. LOUIS, MO.
Representatives in Principal Cities

21 YEARS

BALDOR
BETTER MOTORS

WITH THE MANUFACTURERS

The Swartwout Company, Cleveland, Ohio, has organized The Swartwout Pacific Co., with offices at 560 Seventh St., San Francisco, and complete facilities for manufacturing industrial roof ventilators on the West Coast.

Joseph T. Ryerson & Son, Inc., Chicago, is celebrating its one hundredth year of business. In November, 1842, the founder of the firm, Joseph T. Ryerson, at the age of twenty-nine, went West from Pittsburgh to Chicago and started his small "Pittsburgh Iron Store" on the banks of the Chicago River. In the eventful years that followed, the Ryerson organization grew from a small iron store in muddy pre-railroad Chicago to a nation-wide service with ten key-city plants that measure floor space in acres, spur trackage in miles, and annual shipments in the many thousands of tons.

Carrier Corporation's central regional headquarters in Chicago have been moved to 20 North Wacker Drive, Civic Opera Building. Telephone, Central 9520. *A. P. Shanklin* is vice-president and regional manager.

Anemostat Corporation of America, New York, announces that *Earle Russell* has joined the corporation as district manager of sales for the New York Metropolitan area. Effective with this change Anemostat will no longer be represented by A. F. Hinrichsen & Co., Inc. Mr. Russell was for the last 18 years with Tuttle & Bailey.

The Gurney Foundry Co., Toronto, Ont., is celebrating the one hundredth anniversary of the founding of its business which was first established in Hamilton by *Edward* and *Charles Gurney* who came to Canada from Pennsylvania. The plant is said to be the largest firm of its kind in the British Empire.

PERSONALS & PERSONNEL

Minneapolis-Honeywell Regulator Co., Minneapolis, has appointed *Fred Kaiser* as zone manager of the Chicago zone, replacing *Charles L. Saunders,* who recently resigned to associate himself with the War Production Board at Washington, as chief of the instrument section, Machinery Division. Mr. Kaiser has been for the past three and a half years manager at Detroit, and prior to that, manager at Buffalo and Syracuse, New York. He started as a service-salesman at New York in 1926. Mr. Kaiser will be succeeded by *D. J. Peterson* as branch manager at Detroit. He was formerly branch manager at Buffalo. Mr. Peterson has been with the organization sixteen years, having started as a field service man out of the factory in 1926. He has been manager at Buffalo for over three years. Prior to that he was stationed at Chicago, Minneapolis and Detroit.

Fred Kaiser

D. J. Peterson

W. A. Minkler

William A. Minkler has been appointed sales manager of the catalog products division of Young Radiator Co., Racine, Wis. Mr. Minkler has served as assistant sales manager since 1939, under M. F. May, vice-president in charge of heating, cooling and air conditioning products. Mr. May will continue to supervise the catalog products sales program and, in addition, will do special work in connection with government and war effort activities to which the company is devoting most of its productive capacity during the present emergency. Prior to joining Young Radiator Company, Mr. Minkler was employed in a sales and engineering capacity by Westinghouse Electric & Mfg. Co., at its East Pittsburgh, and Springfield plants and later at the Philadelphia district sales office.

Jas. P. Marsh Corporation, Chicago, has created a new post in its organization to provide for expanded activities of the company. *A. D. Rose,* for many years sales manager, will fill the new post, that of assistant general manager. *James Emmett, Jr.,* formerly assistant sales manager, is now sales manager.

Gar Wood Industries, Inc., Detroit, has elected *Frank H. Dewey* a vice-president of the company. Mr. Dewey has been general manager of the Air Conditioning Division, and will continue these duties.

John Hare, chief branch engineer for the York Ice Machinery Company here, has been made head of the company's marine and navy contracts department in Philadelphia.

The National Radiator Co., Johnstown, Pa., announces that *L. N. Hunter,* vice-president, has been appointed to a position with the War Production Board. Mr. Hunter, who has been in charge of research development for the company, is now an industrial consultant cooperating with the Plumbing and Heating Branch of WPB, representing the cast iron boiler and radiator industry. He is working on the problem of converting manufacturing plants of this industry over to the production of war material.

COMING EVENTS

JUNE 7-9. 29th Spring Meeting of the American Society of Refrigerating Engineers at Skytop Club, Skytop, Pa.

JUNE 10-12. 33rd annual meeting of the National District Heating Association, Dayton-Biltmore Hotel, Dayton, Ohio. Further information from John F. Collins, Jr., secretary, NDHA, 827 N. Euclid Ave., Pittsburgh, Pa.

JUNE 15-17. Semi-annual meeting, American Society of Heating and Ventilating Engineers, Hotel St. Paul, St. Paul, Minn.

H&V'S PHOTOS

Pages 19-20. A. H. Lueddecke Studio, St. Louis.

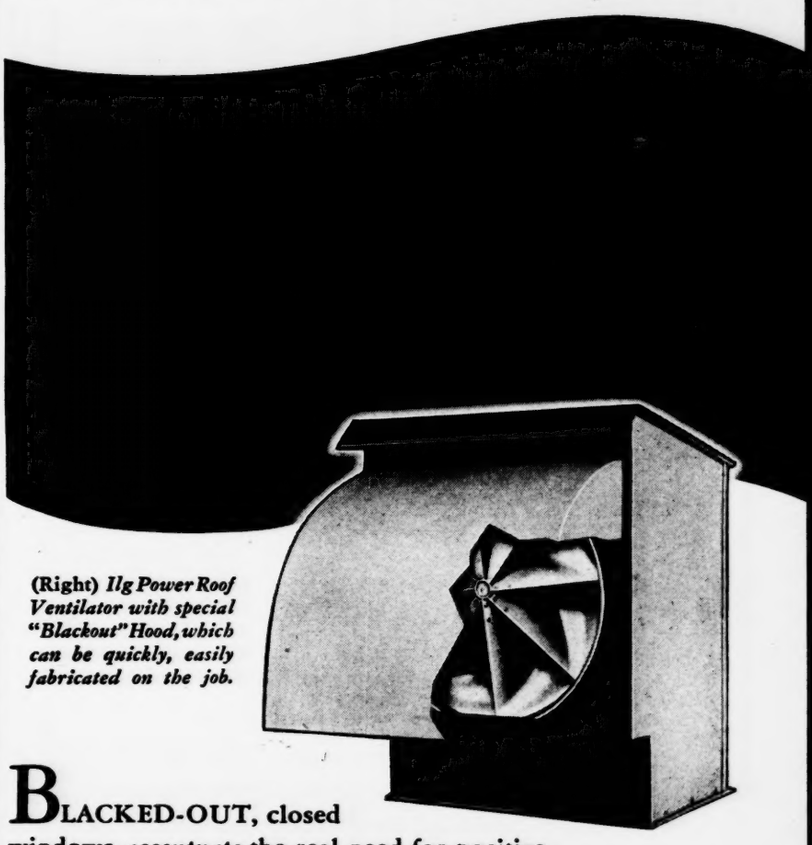
Page 27. Hedrich-Blessing Studio, Chicago.

Page 30. Hill & Knowlton, Cleveland.

Page 64. Office of Emergency Management.

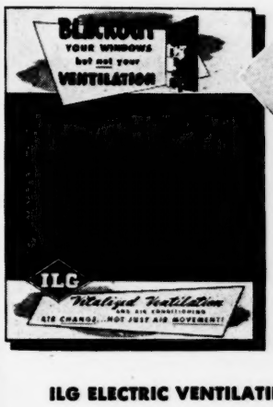
HOW TO SOLVE THE PROBLEM OF

BLACKOUT VENTILATION



(Right) *Ilg Power Roof Ventilator with special "Blackout" Hood, which can be quickly, easily fabricated on the job.*

BLACKED-OUT, closed windows *accentuate* the real need for positive, *adequate* ventilation! From coast to coast, "Blackout" Hoods on Ilg Power Roof Ventilators plus Hooded Fresh Air Inlet Louvers, are now blocking out light from plants, while "worn-out" air, odors, excessive heat, dust or harmful vapors are removed swiftly and quietly—regardless of weather conditions!



NEW BULLETIN 304

Get Your Copy Today!

. . . gives you the complete story on "blackout" ventilation . . . shows a typical Ilg engineered installation . . . illustrates the design of "Blackout" Hoods and positioning of Fresh Air Inlets.

DIMENSION DRAWINGS—of "Blackout" Hoods and Fresh Air Inlets for the specific job you are figuring on will be furnished on request.

ILG ELECTRIC VENTILATING CO., 2858 N. CRAWFORD AVE., CHICAGO, ILL.

OFFICES IN 41 PRINCIPAL CITIES — CONSULT YOUR PHONE DIRECTORY

ILG

Vitalized Ventilation

AND AIR CONDITIONING

AIR CHANGE . . . NOT JUST AIR MOVEMENT!

Eliminate METAL DUCTS IN AIR CONDITIONING

Careyduct Installation in new Greyhound Bus Station—Cincinnati, Ohio

Specify Careyduct

THE ALL-ASBESTOS INSULATED DUCT

Even before the war curtailed the use of metal, CAREYDUCT had won an enviable position in the air conditioning industry for its many outstanding advantages over insulated steel duct. Under present conditions, the fullest utilization of this all-asbestos duct is more essential than ever. In a recent job, 100 car-loads of CAREYDUCT saved many tons of steel.

It has been demonstrated in hundreds of installations that the use of CAREYDUCT means greater efficiency . . . quieter operation . . . lower friction . . . lighter weight . . . easier installation . . . and actually lower cost than insulated metal.

CAREYDUCT is a natural sound absorber and non-conductor of sound. It hushes fan noises; reduces outside noise; eliminates metallic "cracking"; by effectively subduing noise, it allows use of smaller sizes with higher velocities; solves many difficult problems where space is limited. Steel will help win battles. By using CAREYDUCT you conserve steel and insure better air conditioning. Write for full information. Address Dept. 49.

THE PHILIP CAREY MFG. COMPANY • Lockland, Cincinnati, Ohio

Originators of Asbestos Products Since 1873

IN CANADA: THE PHILIP CAREY COMPANY, LTD., OF [illegible], LENNOXVILLE, P. Q.

DE-STA-CO Blower Wheel Housings

of Standard Dimensions

Made in sizes to fit 4½, 5, 6, 7½ and 9 inch wheels and in widths to suit single or double inlet wheels . . . also individual parts for your own assembly.

De-Sta-Co housings are engineered for maximum efficiency and quietness in operation . . . neatly finished. Send for "De-Sta-Co Blower Housings" bulletin; gives complete information, including essential dimensions.

DETROIT STAMPING CO.

Established Over 25 Years

375 Midland Ave • Detroit, Mich.

Oil is AMMUNITION

SAVE IT!

An OIL BURNER HANDBOOK by L. J. Whelan, answers all oil burner problems in the simple, every day language of the contractor, mechanic, or average man. It helps Uncle Sam conserve fuel oil and preserve existing equipment by showing how to keep oil burners operating at maximum efficiency.

Both commercial and domestic burners are discussed in detail. 245 pages, illustrated, with questions at the end of each chapter to test your knowledge. Price, $2.50.

---------- ORDER YOUR COPY FROM ----------

HEATING AND VENTILATING, 148 Lafayette Street, New York

Send me an Oil Burner Handbook, for which I enclose $2.50.

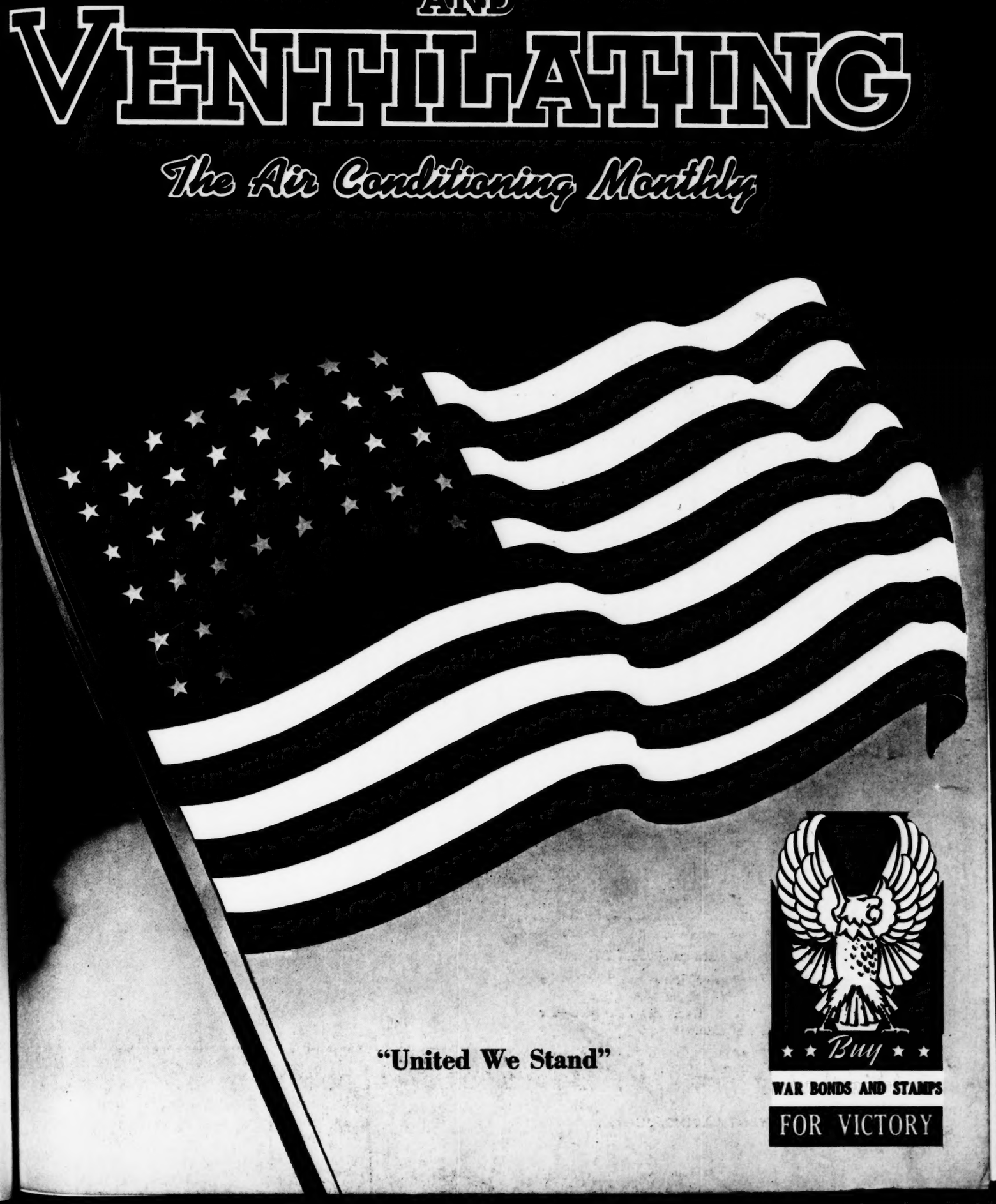
Name .....

Street Address .....

City and State .....

Firm .....

H&V-6/42

HEATING AND VENTILATING

The Air Conditioning Monthly